plating

DECEMBER · 1961

Season's Greetings

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

PLATING MAGAZINE

University Microfilms
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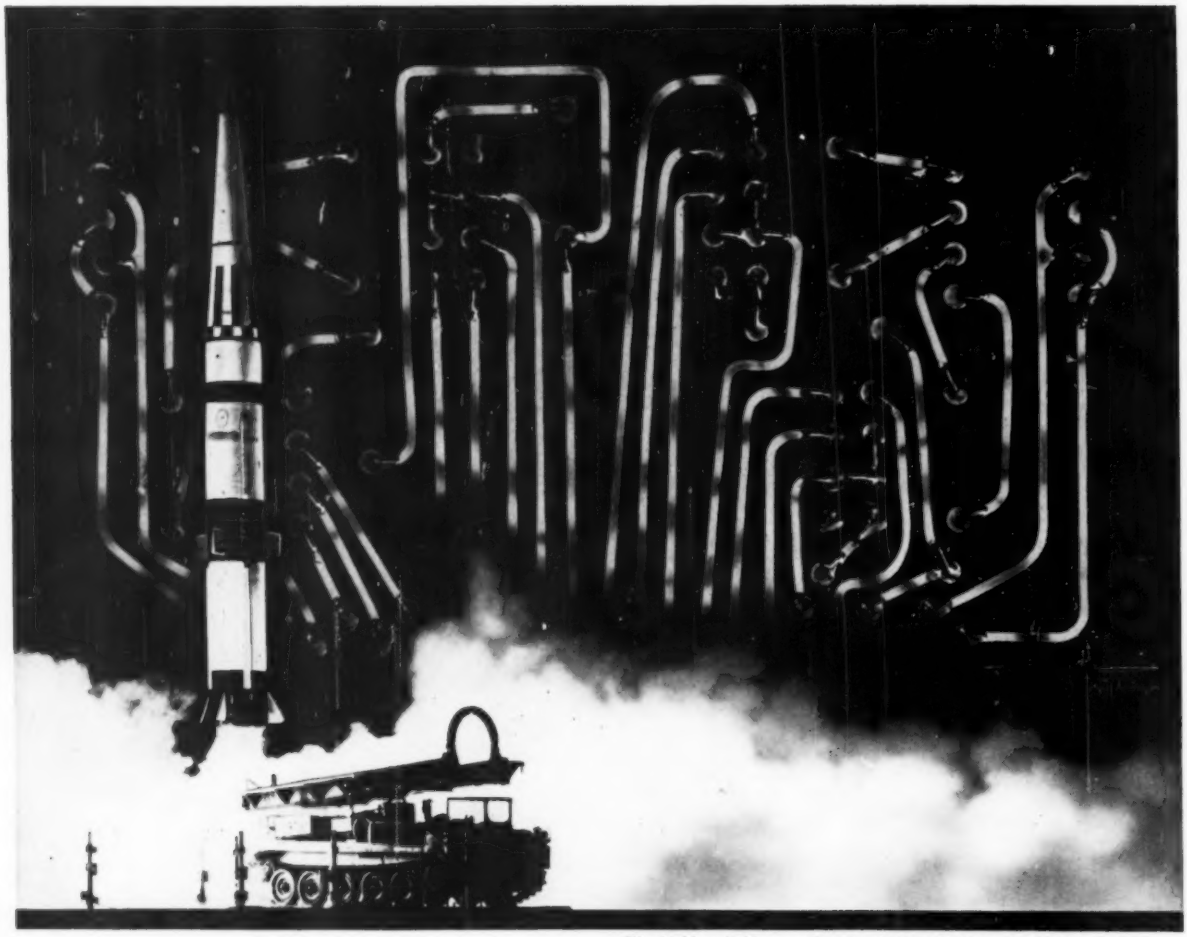
Ann Arbor, Michigan



The highly reliable new Pershing Missile built by the Martin Company

At Dev Tek, Inc.

RIGID PERSHING MISSILE SPECS ARE MET WITH AUTRONEX ACID GOLD PLATING PROCESS*

Dev Tek, Inc., Orlando, Florida, uses the patented Autronex Acid Gold Process to plate circuit conductors. According to Mr. A. F. Goldsby, Dev Tek President, Autronex Acid Gold permits compliance with the rigid ABMA-428 specifications for a hard bright coat of gold alloy 100-150 millionths thick covering all circuit conductors.

Dev Tek is one of the very few manufacturers of electronic components qualified to meet the ABMA Huntsville Specification ABMA-428 and PDS-1C for printed circuits and encapsulated assemblies, as used in the highly reliable new Pershing Missile. The specifications require close control over processes and raw material so that reliability is assured for each part that goes into the missile.

Dev Tek controls the gold bath closely which gives an easy-to-solder-to surface which readily yields the desired ABMA PDS-1C solder joint characteristics of the exacting Pershing workmanship standard.

SEL-REX makes the world's largest selection of processes and systems which take the guesswork out of plating with precious metals. Baths are simply maintained with scientific precision by additions of pre-measured salts or solutions. Your assurance of consistent quality results from one batch to the next.

An internationally based network of sales and service technicians is at your beck and call to make sure you get the optimum results built into every SEL-REX PROCESS.

Complete technical literature free on request. Specify precious metal(s) and your application.

Patented processes for plating with Gold, Rhodium, Platinum, Paladium, Silver, and to produce "custom alloys" for your particular requirements.

*Patented

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NUTLEY 10, NEW JERSEY

The World's Largest Selling Precious Metal Plating Processes

Plating on aluminum made easy

WITH ALUMON "D" DILUTE ZINCATE

BLISTER-FREE PLATING ON COMPLEX PARTS

Alumon "D" quickly penetrates blind holes, screw threads, grooves, other areas difficult to plate using ordinary zincate baths. Adhesion is excellent; solution rinses freely; and carry-over into plating baths is minimized. Parts shown are plated aluminum components of the U.S. Army Hawk missile weapons system produced by Raytheon's Aero-Weapons Division.

REDUCES DRAGOUT

Alumon "D" thin liquid drains rapidly, reducing solution dragout losses to a minimum. In laboratory tests on identical parts, the amount of solution dragged out of an Alumon "D" bath was less than 1/3 the amount dragged out of a conventional zincate bath. The amount of salts dragged out is less than 1/12 as much.

SHORTENS MAKE-UP TIME

Alumon "D" is easy to make up. One hundred gallons of solution requires addition of only 20 gallons of Alumon "D" Liquid (or 100 lbs. of Alumon "D" Powder) to water, compared with dissolution of 450-500 lbs. of powdered chemicals for a conventional bath. For detailed information, write today to: Enthone Incorporated, 442 Elm Street, New Haven 8, Conn.

ALUMON "D" ®

ENTHONE

ANOTHER PRODUCT OF Enthonics RESEARCH

A Subsidiary of American Smelting and Refining Company ASARCO

Somebody was bound to develop better dry acid salts...

Hubbard-Hall Descaler A is here to prove it!

In plating or processing cycles—involving steel, iron, aluminum, brass, copper or zinc—new Descaler A offers many advantages not provided by conventional acid salt compounds. It's readily soluble in water, even in high concentrations at room temperature. There is no salt-out on parts when solution temperatures fall. Surfaces are actually brightened during derusting and no undesirable film is left to affect electroplate adhesion. Non-toxic Descaler A gives off no unpleasant or corrosive fumes even in solution. And this fast-acting compound is entirely safe for iron and steel parts . . . there is no significant attack or stain on the base metal.

Besides Descaler A Hubbard-Hall's chemists have developed three other special-purpose dry acid salts: powerful Descaler B, made to order for many steel applications, Descaler C formulated for use on stainless steel and Descaler D to remove films from aluminum.

Already these new Hubbard-Hall compounds are making many finishing cycles quicker, easier and safer. What about yours? Better ask your Hubbard-Hall Representative for full details or write today for our latest technical bulletins.

PLANNED SERVICE *for better metal finishing*

THE Hubbard Hall CHEMICAL COMPANY • Waterbury, Conn.

FOUNDED 1909

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plating
JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

DECEMBER 1961 — **Vol. 48, No. 12**

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Change of address should reach us by the 15th of the month preceding issue with which it is to go into effect. In sending us your change of address, kindly send old address as well as new one.

PLATING MAGAZINE is indexed in Applied Science and Technology Index and is abstracted regularly in Chemical Abstracts, Metals Review, Metal Working Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, Bulletin Analytique and others.

Harshaw's New 15-Gallon Fluoborate Container

(Fibre, polyethylene lined)

Harshaw is FIRST AGAIN—This time with 15-gallon non-returnable containers for our Fluoborate Plating Solutions. Harshaw, in 1957, was first to use 5-gallon non-returnables.

DEFINITE SAVINGS in work, time, and money are immediate benefits when you order Harshaw Fluoborates in this new polyethylene lined fibre container. Check these advantages:

- No increase in product price
- No containers to return
- No records to keep
- No container deposit
- No return freight charges
- Less freight on incoming shipments
- Lighter containers
- Easier to handle
- Vented surge free pouring
- Specially designed for easy stacking
- Standardized type and size containers

These Harshaw Fluoborates are available now in either 5 or 15 gallon non-returnable containers. Order them by mail or phone.

Cadmium Fluoborate Solution
Copper Fluoborate Solution
Fluoboric Acid
Hydrofluosilicic Acid
Lead Fluoborate Solution
Nickel Fluoborate Solution
Tin Fluoborate Solution
Zinc Fluoborate Solution

HARSHAW

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Hastings-On-Hudson, N.Y. • Philadelphia, Pennsylvania • Pittsburgh, Pennsylvania

Halcyon Day

THE air distance between New York on the Atlantic and Los Angeles on the Pacific is some 2450 air miles. Traversing the "blue yonder" coast-to-coast by early piston aircraft some two decades ago required about 14 hours estimated flying time. Not too long ago, however, modern piston airliners cut that flying span to 7 hours, and today's great jet superliners further diminished it to some 5 hours. The supersonic transport being planned for future service, one hears, will slash more than two-thirds from present jet flying time thereby bringing Knickerbocker within but ninety minutes of the West Coast's "Golden City." Here indeed is an example of the magic of science and the wonders of the Scientific Age to which we have advanced.

The airline instance is, of course, a dramatic but certainly not an isolated example of our scientific progress of the Twentieth Century. The full list is both staggering in its dimensions and in its reaches—air conditioning; the automobile self-starter; bakelite; cellophane; the electron tube; frozen foods; the gyrocompass; television; the cyclotron; the electronic computer; insulin; penicillin; polio vaccine; radar; the rocket motor; uranium fission; cortisone; neoprene; nylon; sulfanilamide; the transistor, so many, many others. And today, our own nation's industry alone is spending $13.5 billion annually in research and development, meaning in advanced creative "outlook" and "ideas."

This is, therefore, the halcyon day of technical and scientific opportunity for the competitively well-educated and well-equipped man and woman. Purposeful youth is taxing the capacity of our colleges and universities, and ambitious men and women, thirsting for further knowledge and self-development, are not only seeking it in higher seats of learning but also in our country's professional Societies, including our own American Electroplaters' Society, Inc. (AES), and on the subscription lists of technical publications, including AES's own PLATING MAGAZINE. Technically and scientifically, civilization has come far indeed.

No sensible observer looking around him and perceiving the ubiquitous stresses and strains of our human and international relations, and experiencing our grave and mounting anxieties, would, however, submit that we are within sight of the millennium, despite our multiplied blessings. Nevertheless we can go forward if we continue boldly to strive for further progress—if we relentlessly continue to plan and work for greater mutual understanding and compatibility, and, in vigilance and strength, for durable peace with honor.

In this spirit, PLATING MAGAZINE extends to each of its readers, to each of its advertisers and their advertising agents, to each and every member of AES, to each and everyone else who deals in any way with the Society, its PLATING MAGAZINE or Research Program, its best wishes for a Happy Christmas and for a healthy, peaceful and rewarding 1962.

John P. Nichols

Chairman, Editorial Board
and Managing Editor

Motor Scooter by Lambretta

When the brightness lasts, you know it's Nickel-Chrome Plating

On cars, bikes... yes, even motor scooters, when the plated parts stay bright-looking despite the worst kind of wear – Nickel-Chrome Plating is the reason why. The stylish scooter shown above – which everybody seems to be buzzing around town on – has more than 30 parts coated with this quality finish for lasting protection against rain, dust, scrapes and bumps.

Plan to use Nickel-Chrome Plating for high-styled beauty that lasts and lasts. Almost any basis metal or fabricating method can be used. For more information on this durable, attractive, corrosion-resistant finish, write for your copy of *The Contribution of Nickel and Chromium to the Durability of Decorative Plating.*

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street INCO New York 5, N. Y.

INCO NICKEL MAKES PLATING PERFORM BETTER LONGER

NUODEX introduces

a series of new high-performance plating baths to complement NUODEX certified plating chemicals.

Two years ago, Nuodex led the industry in bringing you the many advantages of certified metal purity and quality in nickel plating chemicals. Now, with the introduction of high-performance plating baths and brighteners, Nuodex offers you improved control in your plating operations. Each of these four new baths has been specifically developed to overcome and eliminate the more troublesome problems and headaches of nickel and copper production plating.

A new bright nickel process with high leveling properties, high throwing power, ease of control, excellent ductility. May be used with agitated or still bath processes.

A bright barrel process, it may be used in hot barrel solutions or in room temperature baths with equal effectiveness. Simple to maintain and control, it produces highly uniform, bright deposits.

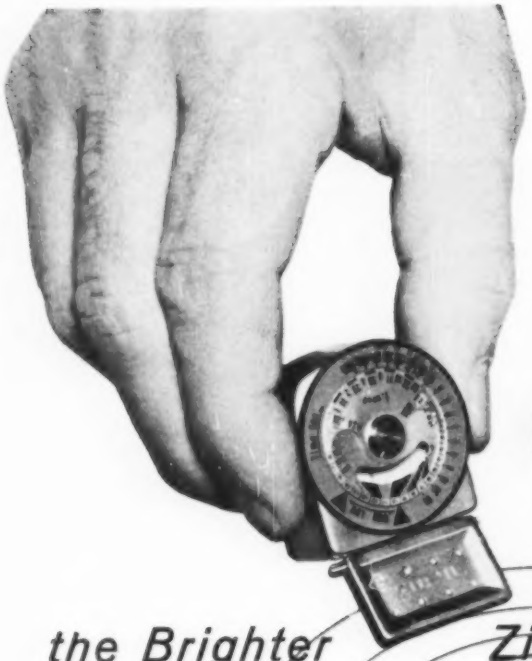
Specifically designed to eliminate stress problems in nickel deposits, it acts as a modifier to reduce high tensile stress to zero or convert it to compressive stress. Produces extremely ductile plate.

This acid copper process has high throwing power, eliminates rough grainy deposits and "treeing" while promoting smooth, hard deposits of high ductility at rapid speeds.

Distributors in principal cities in the U.S.

NUODEX SPECIAL PURPOSE CHEMICALS **PRODUCTS DIVISION** ELIZABETH, NEW JERSEY

HEYDEN NEWPORT CHEMICAL CORPORATION



METER-PROVED

the Brighter Zinc Brightener

ROHCO® 503

• Degrees Brighter • Uniform Coverage • Greater Throwing Power
• Speeds Zinc Plating • More Stability • Goes Farther
• Cuts Costs, Boosts Quality in still and barrel plating

Reports from platers everywhere claim ROHCO 503 Zinc Brightener tops them all for performance. Brings your zinc plating to an all-time high of optimum quality. Better coverage and throwing power for even the most complex shapes. High-concentrate, liquid ROHCO 503 produces chrome-like brightness at only ½% over the cost of ordinary zinc plating. Practically pays for itself in lowering operating costs alone. Unsurpassed as a combination brightener for both still and barrel plating—does job of two ordinary brighteners. By every performance standard, ROHCO 503 is today's most effective, economical and easy-to-use brightener of its type. Call your ROHCO Representative. Ask for FREE Manual.

Nationwide Stockpoints

ROHCO

R. O. HULL & COMPANY, Inc.
1310 Parsons Court • Rocky River 16, Ohio

"The right start . . . a better finish"

CADMIUM PLATING PRODUCTS

ROHCO 20 XL and Super XL: World's leading cadmium brighteners.

ROHCO Cad-Sol: Add water for instant cadmium plating bath.

ZINC PLATING PRODUCTS

ROHCO 100 and ROHCO 102: Barrel zinc brighteners for brilliant, blue-white deposits.

Econobrite: Economical, bright deposits, suitable for post-plating dip.

Perma-Brites: Uniform, commercial finishes at lowest cost.

ROHCO 503: Most popular zinc brightener in plating.

ROHCO Zinc Purifier: Purges zinc plating baths — saves brightener.

ROHCO Zinc Sol: Add water for instant zinc plating bath.

ROHCO ZW-600: Wetting agent for more efficient, cleaner zinc plating.

CONVERSION COATINGS

Rodips CD-3, CD-4, CZ-10, and Roblack for cadmium: Superior post-plating treatments for passivating and coloring cadmium plate.

Rodips ZN-22, ZN-23, ZN-25, ZN-30, etc., for zinc: Superior post-plating treatments for passivating and coloring zinc plate.

Rodip AL-50 for aluminum: Superior chromate treatment imparts corrosion protection to aluminum and its alloys.

OTHER ROHCO PRODUCTS

ROHCO Super No-Cro-Mist and ROHCO Anti-Spray: Spray suppressants for chromium plating baths.

ROHCO Rins-Aid: Water sheddery improves drying, prevents staining.

Rodip AL-44: Improves aluminum brite dips.

Hull Cells, Rectifiers and Related Plating Test Equipment: Wide range of models for every purpose and convenience.

FEDERATED PLATING SUPPLIES

CONSISTENT HIGH QUALITY PLATING WITH TESTED, PROVED MATERIALS

Use these tested, proved-in-use chemicals and anodes for fast, economical, always consistent quality plating:

High efficiency anodes in brass, cadmium, copper, lead, nickel, tin, tin-lead and zinc.

Asarco-Max copper anodes and triple-life Conducta-Core lead anodes.

Asarco nickel salts of high purity and uniformity.

Brighteners: Cadmax (cadmium), Zimax (zinc), Levelmax & Nimax (nickel).

All have set new industry performance standards.

For full information on plating materials and expert help on individual problems, call or write: Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y., RE 2-9500, or call our nearest sales office or Federated plating materials distributor.
In Canada: Federated Metals Canada, Ltd., Toronto and Montreal.

ASARCO

"By plating this part with LEVELUME 220 we slashed polishing time in half"

says JOSEPH T. HINES, Plant Manager, Southern Finishers, Inc., Nashville, Tenn.

A 50% reduction in the time it takes to polish this griddle cover is only *one* of the reasons Southern Finishers, Inc., is so enthusiastic about Levelume 220. This plater of some 500 different parts has cut polishing time one-quarter in *over-all* operations. Copper plating and copper buffing have been done away with on the griddle part and many others—saving up to two steps in seven.

"Appearance is better, too," says Joe Hines, a plater for 16 years. "Levelume 220 hides scratches nicely, plates brighter in recessed areas than any bath I've ever seen."

Southern is plating parts from ½-inch faucet buttons to 64″ x 25″ wire racks. What will Levelume 220 do on what *you're* plating? Ask H-VW-M.

H-VW-M *Progress in metalfinishing through advanced processes • equipment*

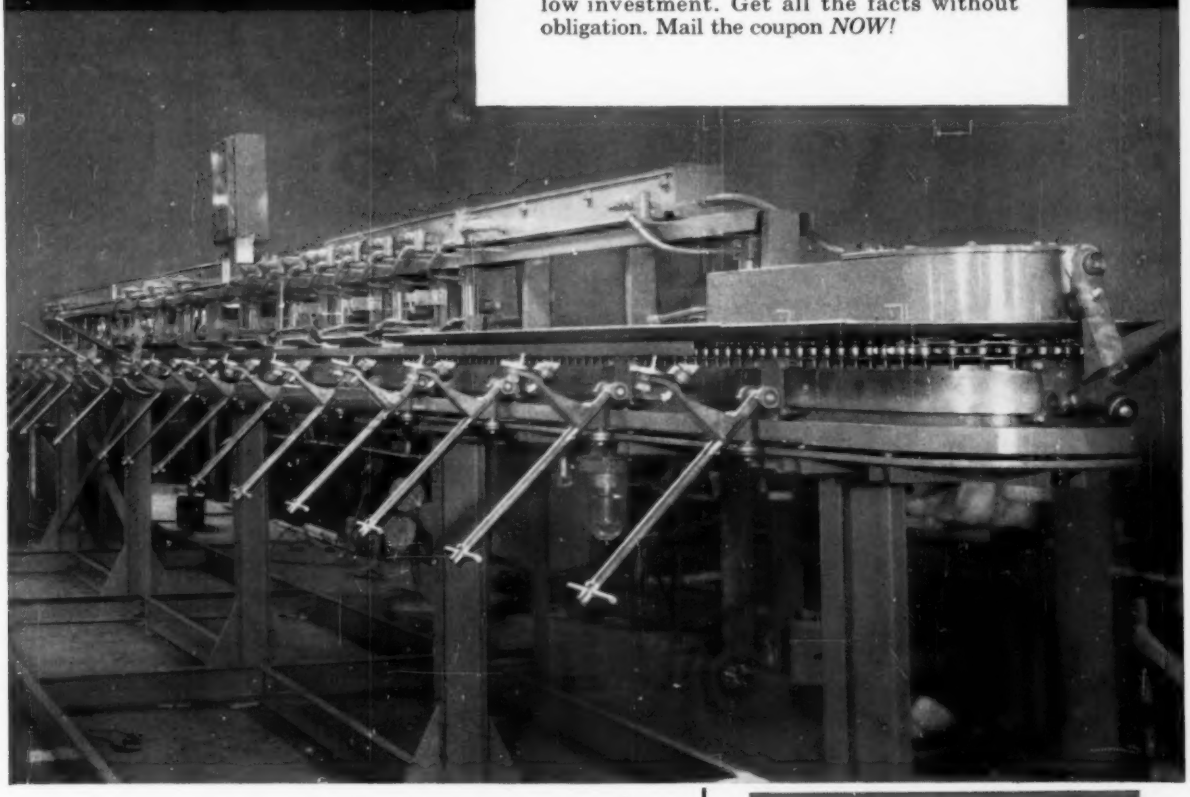
Hanson-Van Winkle-Munning Company, Matawan, New Jersey • Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco

Select-O-Matic

MULTIPLE PROCESS PLATER

Up to 5 or more process cycles ...at the same time ...on one machine ...automatically!

- √ Fully automatic plating at its best . . . efficient, convenient, profitable!
- √ A single Select-O-Matic plater carries any variety of work pieces completely through 2, 3, or any other number of process cycles *simultaneously.*
- √ The operator, at the loading station, simply sets a dial on each carrier to select the process cycle for individual racks. The rest is entirely automatic while the racks travel from start to unloading.
- √ With a Select-O-Matic, different machines for each cycle are unnecessary. Saving in equipment is tremendous. Maintenance is cut to a fraction. All the floor space saved can be put to more productive use.
- √ No matter what your type of operation, Select-O-Matic is easily adaptable—at a surprisingly low investment. Get all the facts without obligation. Mail the coupon *NOW!*



LASALCO, INC.

HOME OFFICE: 2820 LaSalle St. • St. Louis 4, Mo. • PRospect 1-2990
IN TEXAS: 2805 Allen St. • Dallas, Texas • Riverside 7-8093

ATTACH TO COMPANY LETTERHEAD

Let us have information on the fully automatic Select-O-Matic.

Name.....

Title.....

Stevens leadership in metal finishing is based on

experience!

For more than 30 years, Stevens has designed and built electroplating and processing equipment for industry around the world.

Frederic B. Stevens, Inc., has established an unchallenged lead in the design and construction of equipment for the metal plating and processing industry on a world-wide basis. Much of the present high-production efficiency of this industry is a result of Stevens engineering and research efforts.

Stevens offers a complete line of automatic metal finishing equipment designed to handle parts of all sizes . . . from tiniest electronic components to huge automotive stampings. Special equipment can also be engineered to meet individual requirements.

Stevens engineers have designed and built complete plating installations for numerous firms and have advised management on best methods and processes for maximum efficiency. This same complete Custom Design Service from Stevens is readily available to give you best results at the lowest cost.

Requests for additional information regarding machines or processes are welcomed.

Stevens designs and builds superior equipment for the following metal finishing processes:

- Electroplating
- Anodizing
- Dichromate Treating
- Stripping
- Cleaning
- Pickling
- Bright Dipping
- Phosphating
- Washing
- Other Immersion Processing

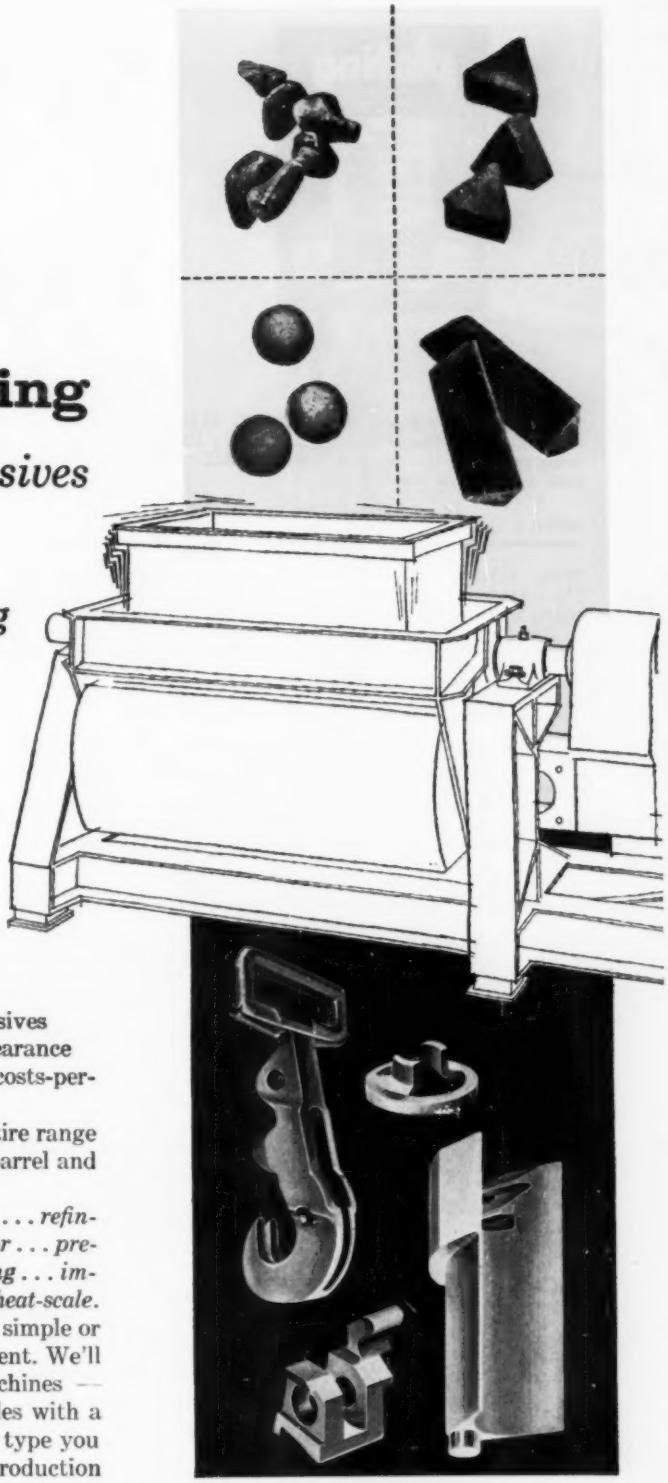
frederic b. STEVENS, inc.
DETROIT 16, MICHIGAN

Buffalo · Chicago · Detroit · Cleveland · Dayton · Wallingford (Conn.) · Indianapolis · Springfield (Ohio)

Barrel finishing is best finishing

...with TUMBLEX® abrasives

... in every type of rotating or vibratory equipment



Keeping pace with the latest advancements in barrel finishing equipment, Norton TUMBLEX abrasives are first in the field for best results with vibratory machines . . . developed for faster, lower cost finishing of the widest range of parts, especially the most complicated.

The recognized advantages of TUMBLEX abrasives help assure improved product quality and appearance — plus the fastest, easiest way to cut finishing costs-per-piece . . . by this new vibration method.

These advantages are also brought to the entire range of barrel finishing operations of both rotating-barrel and vibration types, including:

Removing burrs . . . smoothing off feather edges . . . refining surface finish . . . burnishing for luster or color . . . preparing surfaces for painting, enamelling or plating . . . imparting matte finish . . . removing dirt, grease or heat-scale.

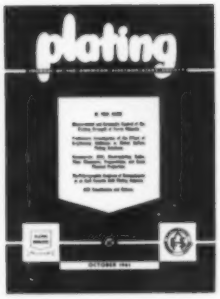
Send your samples of parts — large or small, simple or intricate — to our Sample Processing Department. We'll barrel finish them on the most suitable machines — vibratory or rotating — and return the samples with a report on the TUMBLEX abrasives and machine type you need to improve product quality and cut production costs. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

NORTON
ABRASIVES

G-409

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes



$ QUESTIONS AND $ ANSWERS

TYPICALLY, 92.2% of PLATING MAGAZINE's entire October 1961 print order represented copies mailed to those who had actually PAID for their annual PLATING MAGAZINE subscription, and who compose the largest audited PAID international circulation in the electroplating, metal finishing and allied arts market.[1]

WHAT DOES THIS MEAN TO YOU THE ADVERTISER?

When YOU the Advertiser contract for advertising space in half-century old PLATING MAGAZINE, an 8¼ x 11¼ inch monthly publication affording man-size presentation of your advertisements (at advertising space rates that are, at very least, competitive with those of any comparable monthly magazine in this field), you can be sure that your advertising will be exposed to a readership that has *proved* its interest in PLATING MAGAZINE by *paying* for annual subscription.

WHO ARE THESE PAID SUBSCRIBERS?

Occupationally, these readers include corporate management executives or owners of individually owned plating and metal finishing establishments—plant executives, works managers, production managers, superintendents—metallurgists, chemists, engineers, consultants, testing laboratory specialists—purchasing agents—merchandising, marketing and sales executives and personnel—foremen and artisans, with each element performing an important team role in fortifying the earning and spending power of this important industry so vital to the public interest.

DO PAID SUBSCRIBERS REPEAT THEIR INVESTMENT?

It is equally important to YOU the Advertiser in selecting media that at least 91% of those who invest in an annual PLATING MAGAZINE subscription, whether members or non-members of American Electroplaters' Society, Inc. (PLATING's parent), attest to the value of that investment by *paying* for *renewal* of their subscriptions.[2] This is substantiated, for example, by PLATING MAGAZINE's Publisher's Statement of June 30, 1961, latest available, that pegged the percentage of PLATING's PAID subscription renewals for the twelve-month renewal period covered by that Statement at an astronomic 91%.[2]

NOW THIS $ QUESTION

What kind of extra advertising mileage can YOU the Advertiser earn in the fertile electroplating and metal finishing market from steady, effective advertising in the one and only official monthly magazine of American Electroplaters' Society, Inc.—the prime book that not only serves the largest audited PAID international circulation in this market but which also has a 91% aggregate PAID subscription renewal record to demonstrate the value and appeal of its exacting standards of technical and general article coverage to the bulk of its readership?[2]

AND THIS $ ANSWER

Over 200 Advertisers are answering that question by the fact of their PLATING MAGAZINE advertising. If YOUR company or YOUR client company is not now among them, ask us to send you, without obligation, a copy of PLATING's current "Market Data and Media File".

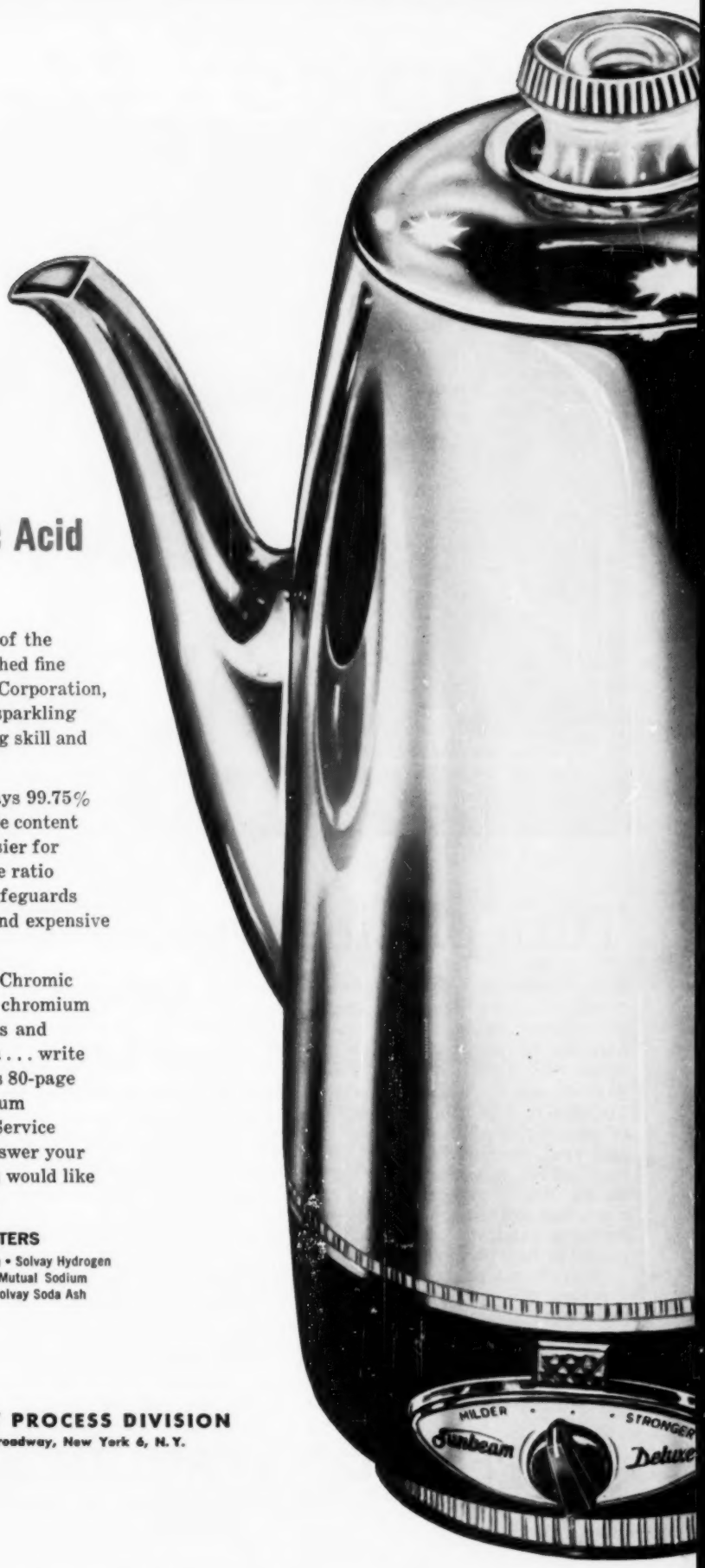
PLATING MAGAZINE

AMERICAN BUILDING • 443-445 BROAD STREET • NEWARK 2, N. J.
Telephone: HUmboldt 2-3400

(1) The balance (7.8%) of that typical monthly print order was disposed as follows: 4.1% are excess copies serving as reservoir to fill back orders, etc., 3.7% were issued, as checking copies, to advertisers and advertising agencies—or as familiarization copies to key advertising prospects—or to PLATING's monthly complimentary list which, for the October 1961 issue, totaled but 91 copies. These October data are by PLATING, not by the Audit Bureau of Circulations (ABC).

(2) Aggregate 91% is based upon publisher's consolidation of renewal percentage data reported in ABC Publisher's Statement of June 30, 1961 [Subscriptions other than Association and Bulk 78.82% (897 renewals of 1138 expirations); Association 93.41% (6961 of 7452); Bulk 87.23% (560 of 642)].

Sunbeam brightens any table with Mutual Chromic Acid



This Coffeemaster is typical of the handsomely and durably finished fine appliances made by Sunbeam Corporation, Chicago, Ill. They owe their sparkling good-looks to Sunbeam plating skill and Mutual® Chromic Acid.

Mutual Chromic Acid is always 99.75% pure—or better. Its low sulfate content (less than 0.1%) makes it easier for you to control the acid-sulfate ratio of your plating bath. This safeguards against plating difficulties—and expensive rejects!

To learn more about Mutual Chromic Acid and the Mutual line of chromium chemicals . . . uses, properties and comprehensive technical data . . . write for your free copy of Solvay's 80-page Technical Bulletin, "Chromium Chemicals." Our Technical Service Staff will also be happy to answer your questions. State whether you would like to have a representative call.

SOLVAY® PRODUCTS FOR PLATERS

Mutual Chromic Acid • Solvay Caustic Soda • Solvay Hydrogen Peroxide • Solvay Methylene Chloride • Mutual Sodium Chromate • Mutual Sodium Bichromate • Solvay Soda Ash

Allied Chemical

SOLVAY PROCESS DIVISION
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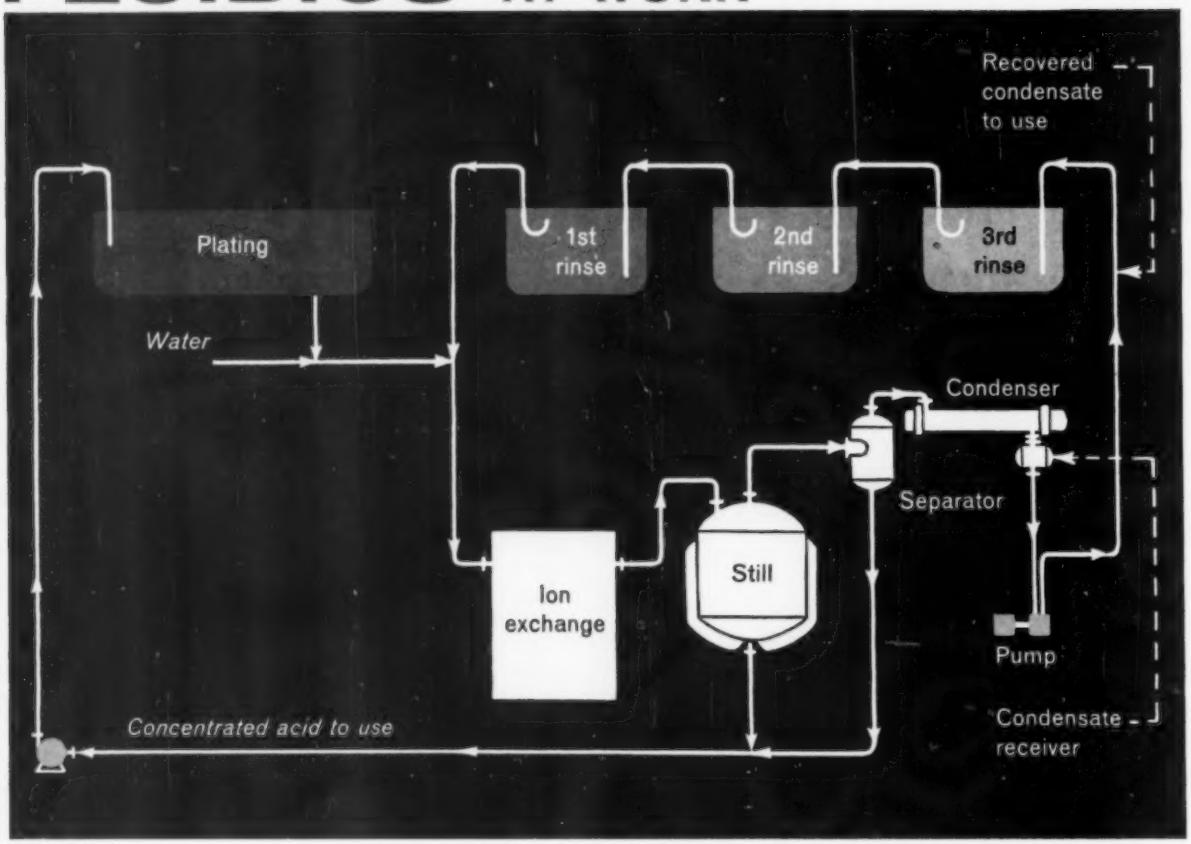

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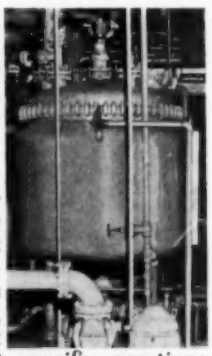

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Hydrogen Embrittlement In Metal Finishing, edited by Harold J. Read, 213 pp., sponsored by the American Electroplaters' Society, Inc., Non-members $7.50, AES Members $6.50. (See advertisement pg. 1350)

It should be noted that this book is slanted towards the problems and needs of metal finishing, and does not cover all of the more general ramifications of hydrogen embrittlement. It is based on eight papers presented at a symposium held at the Los Angeles meeting of the American Electroplaters' Society in July 1960. However, Dr. Read has done a remarkably fine job of editing the papers into a useful book form, and has added a ninth chapter on some more practical aspects of the control of hydrogen embrittlement, and to review some recent work.

Likewise, the Reinhold Publishing Corporation has done the very excellent job of book production for which it is noted. An adequate subject index permits one to locate specific information regardless of the chapter or chapters containing it. An author index such as is common in German books would have been helpful also.

Dr. Read covers "Metallurgical Aspects" in the first chapter (pages 1–19), and this provides an introduction to many fundamentals of metal fracture. He concludes with general recommendations for the removal or avoidance of hydrogen embrittlement.

"The Mechanism of Transport of Hydrogen Across a Solution-Metal Interface" is discussed by R. J. Barton in Chapter 2 (pages 20–45). Present theories of hydrogen evolution and over-voltage are described, and an effort is made to apply these theories to the entry and release from metals. While this is an excellent fundamental approach, the chapter seems to fail to contribute much useful knowledge towards the solution of the problems of the book as a whole.

Chapter 3 (pages 46–80) by M. L. Hill on "The Behavior of Hydrogen in Iron and Steel" is the longest and makes a very fine contribution. The theories on the mechanism of embrittlement are first discussed and this is followed by a review of the solubility and diffusivity. The lack of solubility of hydrogen in iron and steel at room temperature is emphasized, and its concentration in voids or cracks is a major feature of embrittlement.

"Measurements Pertaining to Hydrogen Embrittlement" are admirably covered by C. A. Snavely in Chapter 4 (pages 81–96). The determination of hydrogen in steel and methods for producing hydrogen charged specimens are reviewed. Under mechanical testing the stress-rupture, tensile and bend tests are described, and their relative usefulness is indicated. The need for a simple shop test is emphasized. Under special tests the electrical resistance method for crack detection, heat tinting to show cracked surfaces, and hydrogen permeation and diffusion measurements are described.

Dr. Snavely accepts electrode potential measurements as to a means of following hydrogen diffusion through thin sheets of metal on the basis of the early work of Schmidt and the more recent work of Fischer and Heiling. However, Professor Fischer has disclosed that he obtained no diffusion in purified solutions (J. Chim. Phys. 49, C96, January, 1952). It was shown that this type of diffusion does not occur through sound metal (Trans. Electrochem. Soc. **64,** 221, 1933), but unfortunately the finding has not found acceptance and is commonly overlooked. Similarly, the extremely high hydrogen pressures which may build up inside of metal and cause blistering were explained as due to capillarity. A proper understanding of these phenomena is necessary for further progress.

A new hydrogen detection gage is described in Chapter 5 (pages 97–108) by S. C. Lawrence Jr. This makes use of a metal-encased vacuum tube with the metal case being subjected to the treatment in question.

Chapter 6 (pages 109–138) reports a detailed study of hydrogen embrittlement in high strength steels coated with cadmium by different processes, by N. M. Geyer, G. W. Lawless and B. Cohen. A sensitive notched tensile test for embrittlement was also developed.

In Chapter 7 (pages 139–165) W. Beck and E. J. Jankowsky find that undercoats of pyrophosphate copper and Watts-type

(Continued on page 1300)

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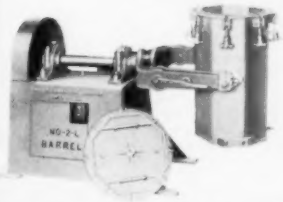

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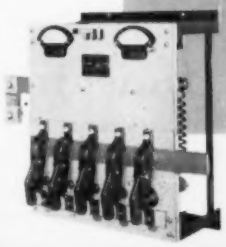

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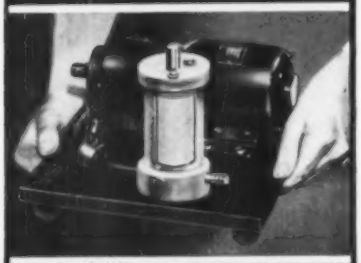

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bright nickel give a marked decrease in the embrittlement of ultra-high-strength steel due to cyanide cadmium plating or to chromium plating. Cathodic charging processes were investigated also.

Chapter 8 (pages 166–182) is by W. F. Hamilton and M. Levine, and is the last in the symposium. It relates entirely to work on the control of embrittlement from cyanide cadmium baths containing nitrate.

The final Chapter (pages 183–206) is a review of some recent studies and a discussion of the control of hydrogen embrittlement by Dr. Read. Specifications giving baking treatments for the relief of the embrittlement are critically reviewed. Other topics discussed include the control of embrittlement with plain carbon, high-strength, and stainless steels, the influence of cold work, nonferrous metals and alloys, non-cyanide cadmium plating baths, miscellaneous plating and etching processes, and embrittlement due to corrosion reactions.

This book can hardly be considered the "be all and end all" of hydrogen embrittlement, but it will be extremely useful to everyone concerned with this problem. The National Bureau of Standards Circular 511 published in 1951 gave a very comprehensive review of the literature through 1949. While the present work does not systematically up-date the review, it goes a very long way in that direction, and essentially serves the purpose while going a very large step further in making clear the solutions to various problems.

Dr. George Dubpernell
Metal & Thermit Corporation
Research Laboratory
Detroit, Michigan

Water Treatment for Industrial and Other Uses—2nd edition by Eskel Nordell, 528 pages. Non-members $12.00, AES members $10.50.

It is becoming clearer to more people than ever before that water is our most important natural resource. Although actual consumption of water by industry is very small, the use of water is enormous. This means that water must be used over and over again and treatment of water, virgin from a well or prostituted many times upstream by other industries, is necessary to provide a water of appropriate quality for various uses. The author has prepared a comprehensive guide in "Water Treatment for Industrial and Other Uses." The second edition has followed the plan of the previous editions with separate chapters devoted to specific water treatments after a few chapters describing water supplies and the characteristics of water.

The book is well written, the format is good and the numerous illustrations and line drawings are helpful. Consequently, the layman will find it to be an excellent source of information and even the specialist will find the book useful because of the specific details included.

The section on electroplating overemphasizes the need for zero hardness water. Certainly, it is desirable to use soft water to prepare cleaner solutions, but most cleaners are designed with built-in softeners, so they may be used satisfactorily in water up to 10-grain hardness. The statement that carbonates are harmful in silver baths caused the reviewer's eyebrows to twitch a bit, although he agrees that demineralized water should be used for the make-up of silver plating solutions.

Specifically, industrial, institutional municipal conditioning, boiler feed waters, cooling waters as well as aeration, deaeration, chemical feeding sedimentation, iron and manganese removal and ion exchange are discussed. Often a book of this sort is not well documented. Eskel Nordell, however, has provided extensive bibliographies at the end of each chapter.

There are many notes which add to the interest of this volume, including one on the dowser and his misty-eyed admirers which is so well done that after a moment's thought one realizes that the chief reason why reading the book was almost effortless and the review not a chore at all is simply that the writing is very well done.

Dr. D. Gardner Foulke
Research Director
Sel-Rex Corporation.
Nutley, N. J.

♦

CHEMICAL CONTOUR DOUBLES PLANT AREA

Chemical Contour Corporation has begun an expansion of its Gardena facility which will double the present plant area, James H. Langworthy, president of the chemical milling firm, has announced. This is the second major addition to the company's plant undertaken this year, and will result in a tripling of square footage within a one-year span.

Construction work is now under way on an additional 30,000 sq ft of roofed plant area, which will bring the total to 60,000 sq ft. Completion is scheduled by next February. Earlier this year Chemical Contour completed a 50 per cent expansion by the addition of 10,000 sq ft to its plant.

To provide needed ground area for the construction program and other purposes, the company has taken over an additional four acres adjacent to the four it previously occupied.

Approximately 10,000 sq ft of the additional space will be used in the processing of parts for the Boeing 727 commercial jet transport, Mr. Langworthy stated. Chemical Contour was recently awarded a $600,000 contract from Boeing for chemical milling of aluminum wing components for the plane. The remaining 20,000 sq ft of new plant area is needed for production work on some 20 other aircraft and space chemical milling projects, he reported.

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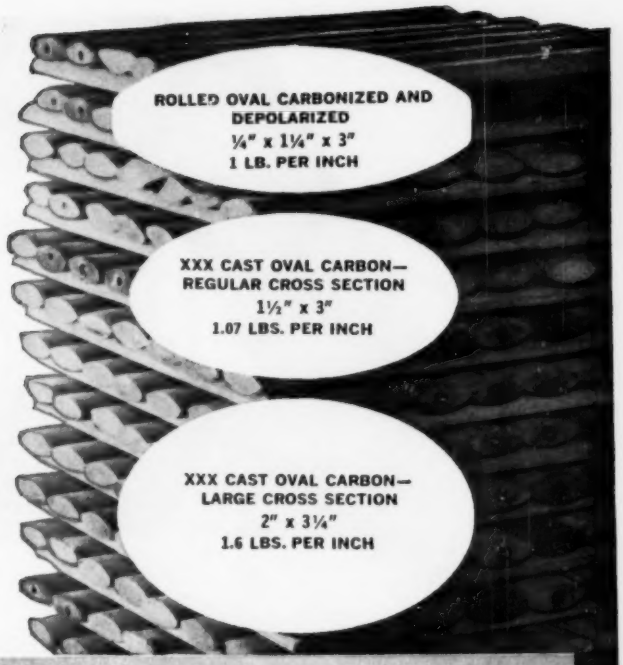

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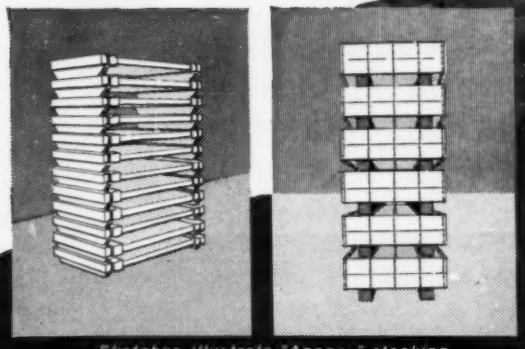

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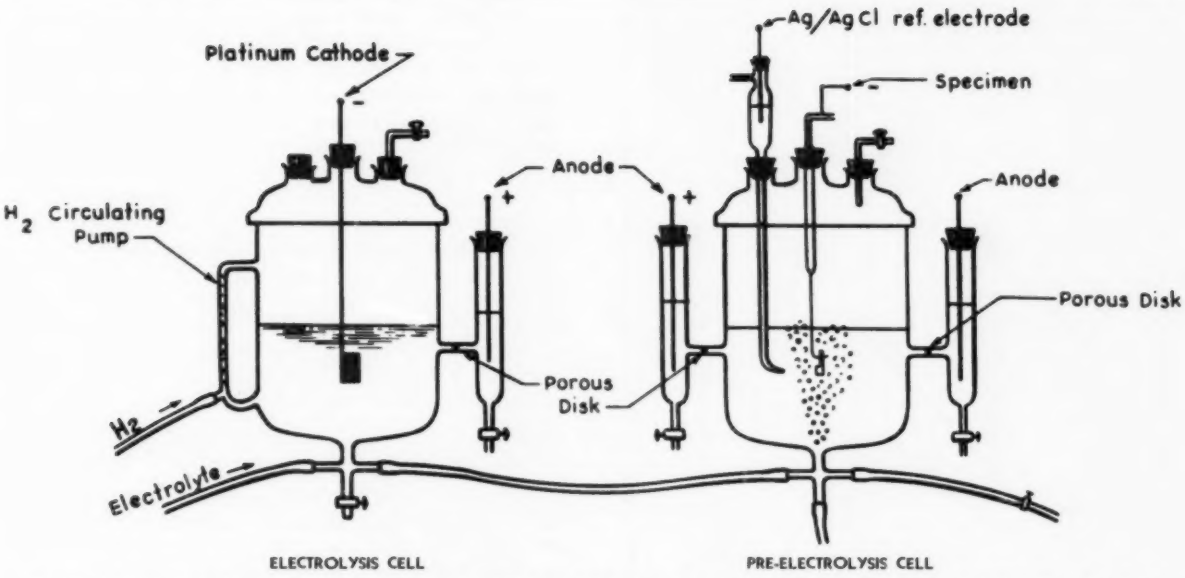

Fig. 1. Equipment used for coulometric analyses. Impurities are "plated out" of the electrolyte in the pre-electrolysis cell, and then the .1N NH_4Cl solution is transferred to the main cell. Identification of the particular oxide is made by measuring the reduction potential, and the quantity is determined by measuring the time and current.

COPPER OXIDES ON THE SURFACE OF GOLD PLATE

by M. S. FRANT*

ABSTRACT

Significant quantities of copper oxides were found on the surface of electrodeposited gold specimens after relatively short heating times at 200° and 275°. Both cuprous and cupric oxides were measured using coulometric reduction techniques. Data are given on the effect of gold thickness, temperature, and type of deposit. The results are shown to be consistent with a mechanism involving diffusion of the copper to the surface, followed by oxidation.

I. INTRODUCTION

THE ENTIRE FIELD of electrical contacts and connections has been affected in recent years by a greatly increased emphasis on reliability, made necessary by the growing complexity of electronic equipment, the use of low-voltage circuitry, and the utilization of solid state devices. The existence of tarnish films on contacts is of little consequence above the so-called "wetting" or "puncturing voltage",[1] but becomes of great practical importance in communications and information circuits operating at 0.1 volts or less.[2] One of the results of the emphasis on reliability and low voltage applications has been a marked increase in the use of precious metal electrodeposits, particularly gold.[3] Gold has the particular advantages of softness,[4] of resistance to corrosive environments, and of having virtually no oxide film.[5]

Industrial experience has been that very thin (30–40 microinches, 8–10 microns) coatings of gold directly over copper or brass do not give satisfactory performance even under static conditions; several alternate techniques are in use—either multiplex coatings (gold-nickel, gold-silver, gold-palladium-silver) or substantially thicker gold coatings (300–400 microinches, 80–100 microns).

Baker[6] found that in outdoor exposure tests thick deposits of gold on copper alloys were superior to thin deposits over another metal, such as nickel, which in turn was plated on the copper alloy. He ascribed this to the fact that the thin coatings were more porous, and felt that this enabled the atmospheric contaminants to attack the underlying metals. If porosity is the major difficulty with gold plate then further progress lies in the direction of either less porous or thicker platings.

However, there is another possibility: copper, silver, zinc, and nickel are all known to diffuse (or migrate) through gold at varying rates. If these metals appeared on the surface, they would be corroded or oxidized. The resulting oxides would be indistinguishable from those caused by a porosity mechanism. If diffusion is the main factor in the formation of oxide films on gold plate, the ideal undercoat would be one that copper and zinc diffuse through with difficulty, and which itself diffuses very slowly into gold.

Most sensitive electronic equipment is not subjected to direct outdoor exposure, but is often used at operating tem-

*Research Division, AMP Inc., Harrisburg, Pennsylvania.

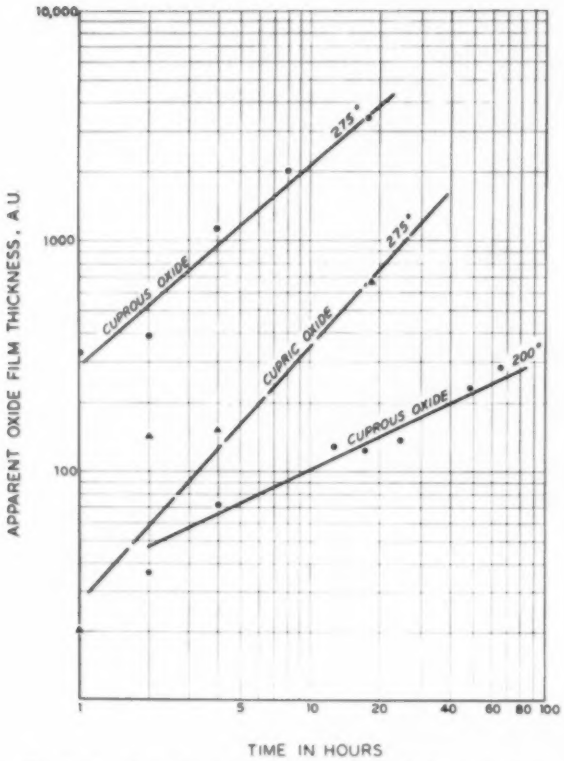

Fig. 2. Log-log plot of apparent oxide film thickness vs. time of heating. Conventional hot-cyanide gold plate, average thickness, 11 microinches (0.28 microns). No CuO was detected on the samples at 200° C.

peratures well above ambient. It appeared possible to determine whether under these conditions the problem is primarily one of gold porosity, or of solid state diffusion, provided the oxides on the surface could be measured quantitatively. It has recently been reported[7] that the chemical porosity of gold on copper varies with gold thickness according to the relationship

$$P = as^{-n} \tag{1}$$

where P is the chemical porosity, a is a constant, s is the thickness of the gold coating, and n varies between 1.3 and 2, depending on the chemical composition of the goldplating bath used. For deposits from the conventional hot-cyanide gold baths, n was 1.7; for the alkaline cyanide bath reported below, n was 1.5; for the acid bath, n was 1.6. On the other hand, as is shown below, the amount of oxide formed by diffusion would be expected to be linearly proportional to the reciprocal of the plating thickness. Therefore, measurement of the amount of oxide as a function of gold thickness ought to yield a relationship where the amount of oxide decreases exponentially with increasing thickness if the corrosion mechanism is due to porosity, and a linear relationship if it is due to diffusion.

The diffusion constant (8, 9) for copper diffusing into a flat sheet of gold can be given by

$$D = D_o e^{-E/RT} \tag{2}$$

If one assumes that the concentration of copper at the outer surface is essentially zero (all of the copper reaching the surface is rapidly oxidized), and that the thickness of the resulting oxide is negligible in comparison to the gold thickness, then for the steady state condition:

Amount of copper diffused per unit area =

$$\frac{D\,Co\,t}{s} = S^* \tag{3}$$

where Co = concentration of copper at the intermetallic interface, t = time, and s = gold thickness. Combining (2) and (3,)

$$S^* = \frac{Do\,Co\,t}{s} e^{-E/RT} \tag{4}$$

The thickness of oxide film after time t would be

$$\tau = \frac{S^*}{P}\,\frac{Wo}{Wc} \tag{5}$$

and

$$\tau = \left(\frac{Do\,t}{s}\right)\left(\frac{d}{p}\right)\left(\frac{Wo}{Wc}\right) e^{-E/RT} \tag{6}$$

where d/p is the ratio of the density of copper to the density of oxide, and Wo/Wc is the copper content of the oxide film.

Thus, for a diffusion-based mechanism, the amount of oxides on the surface ought to be proportional to the reciprocal of the gold thickness, vary directly with time, and exponentially with temperature.

In order to measure the amount of oxide formed, the coulometric analysis technique first developed by Miley[10] and Campbell and Thomas[11] was used, although minor modifications suggested by the work of Albano[12] and Lambert and Trevoy[13] were incorporated into our apparatus. It is believed that this is, however, the first instance of its use to measure basis metal oxide on a plated coating.

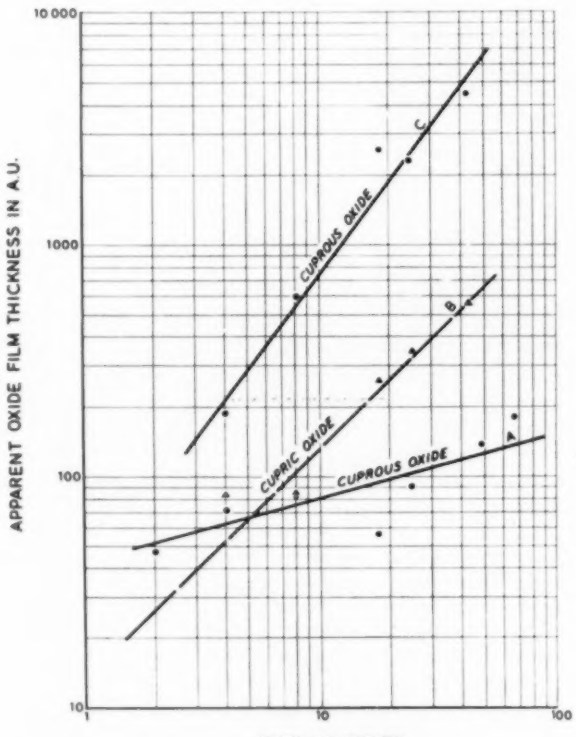

Fig. 3. Log-log plot of apparent oxide film thickness vs. time of heating. Conventional hot-cyanide gold plate. A—21 microinches (.53 microns) average thickness, heated at 200°; B and C—27 microinches (0.69 microns), heated at 275° C.

II. EXPERIMENTAL

The samples used were stamped from O.F.H.C. grade copper. Each specimen had a macroscopic surface area of 0.38 in.,* was about 0.6 inches long, and was made from a metal configuration that was available as a mass-produced item having close manufacturing tolerances. All of the samples were prepared by plating several thousand pieces in a "6 by 12 inch" barrel in commercial facilities. Plating thickness measurements were made by X-ray fluorescence.[14]

The experimental details of the coulometric method have been adequately described in the previous literature. The cell is shown in Fig. 1, and was prepared from a one-liter resin kettle, modified as shown. Because the method is sensitive to oxygen, hydrogen was used as the inert atmosphere. Ten 90-volt batteries in parallel were used as the power supply and the current controlled by a series resistor. For most of the work reported here, the potential changes at the cathode were recorded with a Varian G-11 Recorder. More recently we have been using a dual channel Sanborn Model 60 recorder, simultaneously differentiating the signal and recording it as the second channel. This has aided greatly in the identification and location of endpoints.

III. RESULTS AND DISCUSSION

Figures 2, 3, and 4 show the amounts and type of copper oxides found on conventional hot-cyanide gold plate[15] of various thicknesses after heating at 200° and 275°C. Each point represents the average of 5–8 individual determinations. The results are given as "apparent oxide thickness" since the real area of the surface is not known.[16]

Significant quantities of copper oxide were formed on relatively thin gold plate after several hours of heating at 200° and 275°. Only cuprous oxide was detected at the lower temperature, while both oxides were found at the upper temperature.

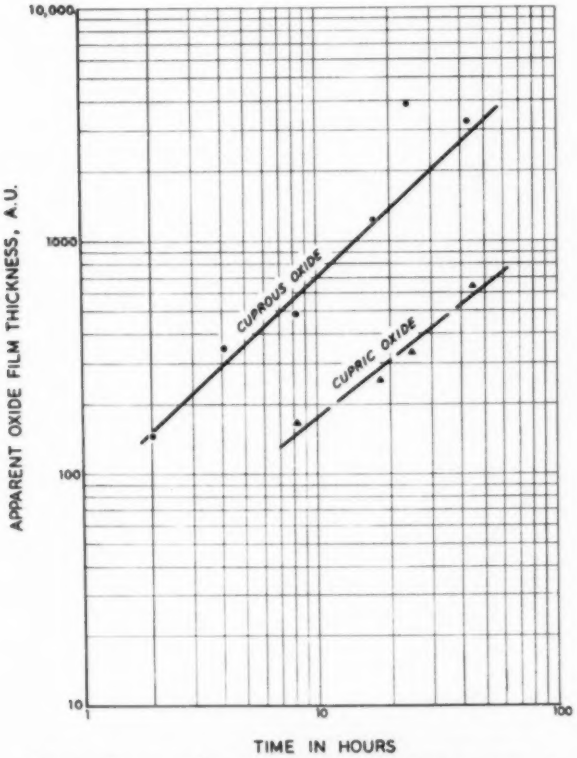

Fig. 4. Cupric and cuprous oxide film thickness vs. time of heating at 275°. Conventional hot-cyanide gold, average thickness 37 microinches (0.94 microns). Log-log plot.

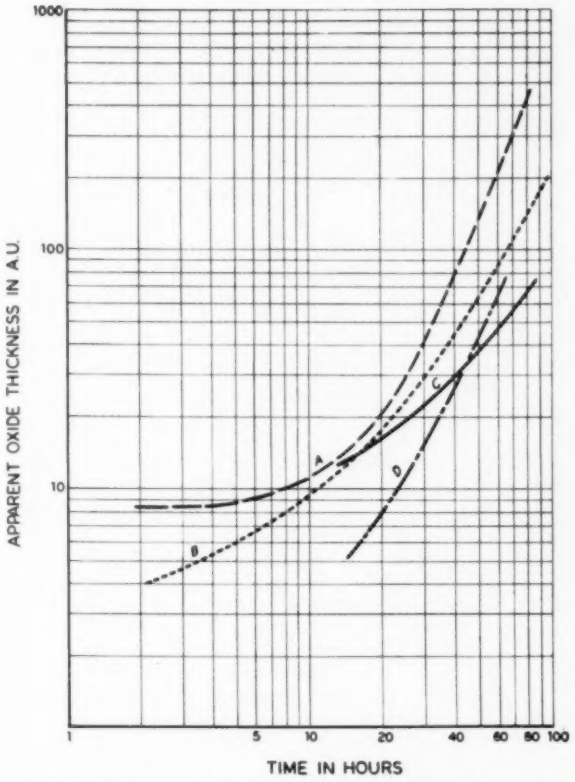

Fig. 5. Cuprous oxide thickness vs. time of heating at 200° for gold plated samples prepared in a proprietary alkaline cyanide bath containing brightening agents. No cupric oxide was found at this temperature. Plating thicknesses: A—15 microinches, 0.38 microns; B—34 microinches, 0.86 microns; C—52 microinches, 1.3 microns; D—67 microinches, 1.7 microns. Log-log plot.

The slopes at 200° are smaller than at 275°. Not only does the amount of oxide formed increase with temperature, but the rate of increase goes up with increasing temperature. This would be expected if the slopes were dependent on the diffusion coefficient, which varies exponentially with the absolute temperature. The basis for the assumption (used in deriving equation 3) that the amount of oxide formed is limited by the diffusion through the gold, rather than by the rate of oxidation at the surface, may be seen by reference to Figs. 2–4, where the slopes are almost all 1 or greater. A plot of copper oxide formation on copper at these temperatures should have a slope of 0.5—that is, copper oxidation has been reported to be a parabolic function in the temperature range 218–289°.[10b] The order of magnitude of the oxide film thickness agrees with that calculated from Equation 6.* Exact agreement was not expected because the assumptions listed above are only approximately valid at best, and other effects, such as the diffusion of gold into the copper, have been neglected.

In general, the results obtained from proprietary gold plating baths showed greater variability than those from the ordinary hot-cyanide bath. The variations are sufficiently great to preclude using these slopes as an indication of mechanism. It is felt that the results are, nonetheless, of

*Using the values given in (9), heating a 100 microinch gold coating for 10 hours at 275° should yield an 80 Å Cu_2O oxide film.

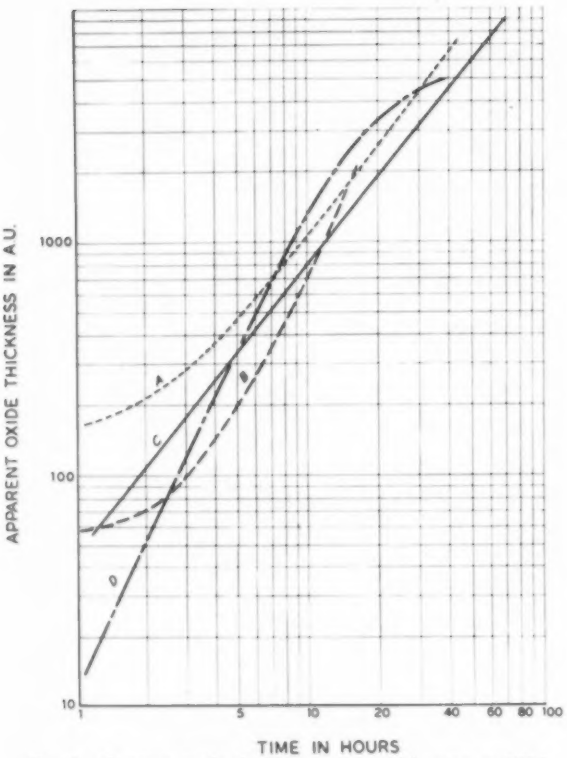

Fig. 6. Cuprous oxide thickness vs. time of heating at 275° for gold plated samples prepared in a proprietary alkaline cyanide bath containing brightening agents. For thicknesses see Fig. 5. Log-log plot.

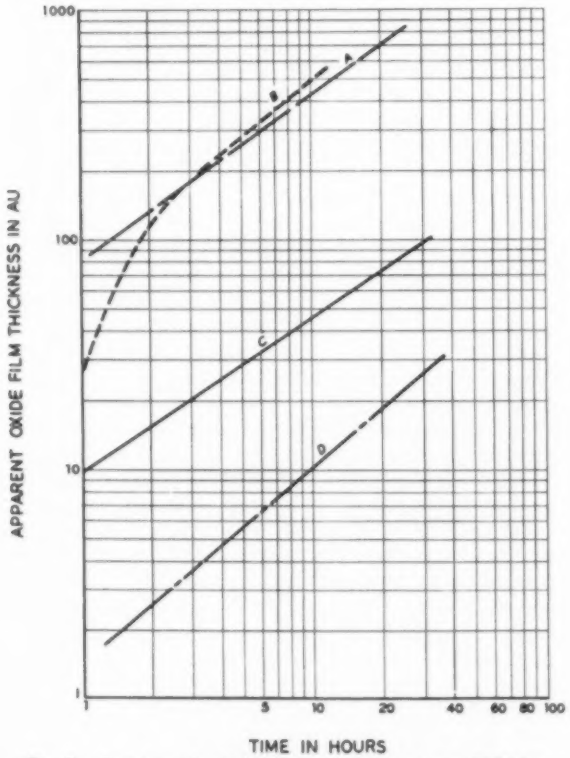

Fig. 7. Cupric oxide thickness vs. time of heating at 275° for gold plated samples prepared in a proprietary alkaline cyanide bath containing brightening agents. For thicknesses see Fig. 5. Log-log plot.

interest to platers and to electronic equipment designers. Figures 5–7 show the amounts of cuprous and cupric oxides formed on the surface of gold prepared in a widely-used proprietary goldplating bath. Analysis of the bath indicated that it was an alkaline cyanide type, containing about one per cent silver cyanide as a brightening agent. As expected, the thinner gold plates had the heavier oxide coatings. The oxide films formed at 275° are about two orders of magnitude thicker than those formed at 200° in the same time interval, which again agrees reasonably well with theory.

The results obtained on another proprietary gold bath, an acid citrate-buffered type, are shown in Fig. 8. The deposit was found to contain small amounts of nickel and cobalt. The amount of oxide is much less for equivalent thicknesses for the acid gold than for samples from the alkaline cyanide proprietary bath. The reason for the difference is not known. The bath manufacturer has reported that the acid gold bath produces deposits with a structure laminated parallel to the surface, while the alkaline bath produces an amorphous, extremely fine-grained structure.[17] In view of the possibility that diffusion occurs mainly along internal surfaces,[18] such as grain boundaries, rather than through the lattice, the effect of crystal structure would be of considerable importance in determining the amount of oxide on the surface.

If the observed copper oxides are primarily due to copper which has diffused through the gold plate, then (based on the discussion earlier) at constant temperature the amount of oxide per unit exposure time ought to be proportional to the reciprocal of the plating thickness. Figures 9 and 10 show the results of two tests on individual pieces of known thickness, using the same hot-cyanide gold referred to previously. A generally linear relationship exists, except when the

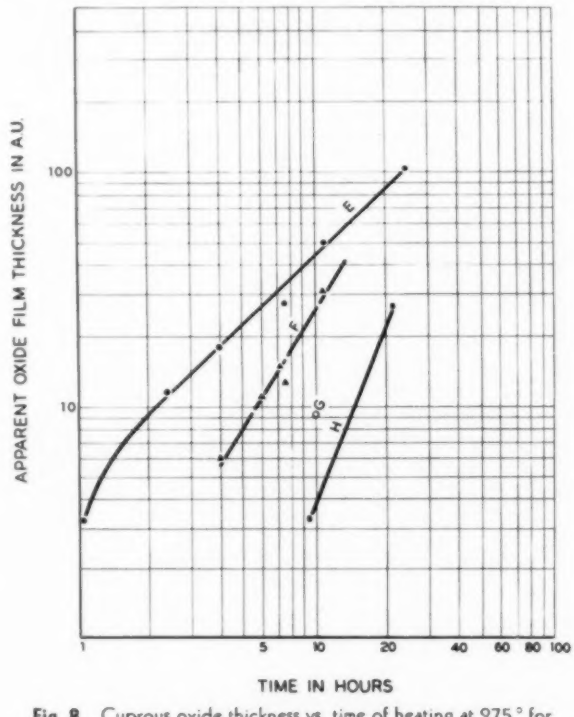

Fig. 8. Cuprous oxide thickness vs. time of heating at 275° for gold plated samples prepared in a proprietary acid citrate bath. Plating thicknesses: E—60 microinches, 1.5 microns; F—90 microinches, 2.3 microns; G—115 microinches, 2.9 microns; H—155 microinches, 3.9 microns. Log-log plot.

gold thickness is such that little or no copper can reach the surface during the heating time.

It would appear then, that at moderately elevated temperatures (and presumably over longer time periods at lower temperatures) electrically-significant[19] quantities of oxides can form on gold plated copper by diffusion of copper to the surface. As indicated above, the practical consequences of this suggest the advisability of a "diffusion-barrier" between the copper basis metal and the gold coatings. Such barriers are presently under investigation.

ACKNOWLEDGMENT

The author wishes to acknowledge the aid of Richard Zimmerman in running all of the gold thickness measurements, and of R. Rajaraman for his capable assistance.

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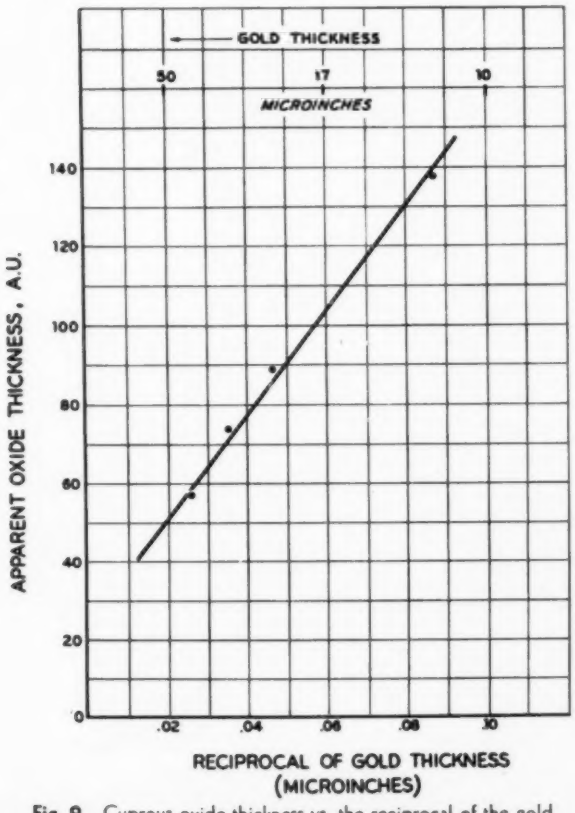

Fig. 9. Cuprous oxide thickness vs. the reciprocal of the gold thickness in microinches. Individual pieces heated 24 hours at 200°. Samples prepared in a conventional hot-cyanide bath. 10 microinches = 0.254 microns.

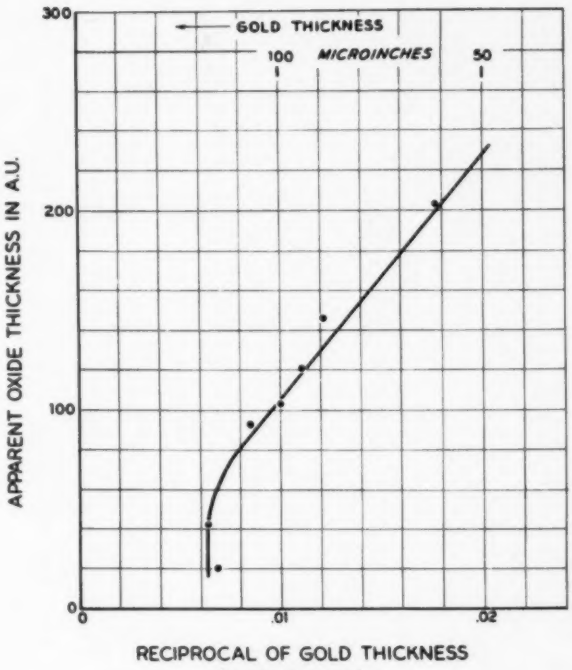

Fig. 10. Cuprous oxide thickness vs. the reciprocal of the gold thickness in microinches. Individual pieces heated 16 hours at 275°. Samples prepared in a conventional hot-cyanide bath. 10 microinches = 0.254 microns.

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TOWARD PROTECTIVE-DECORATIVE CHROMIUM PLATING

by ROGER L. SAUR*

ABSTRACT

An increase in chromium discontinuities increases the area of underlying nickel corrosion. Inspection of parts from both service and the CASS (copper chloride modified acetic acid salt spray) test shows that an increase in exposed nickel area is usually associated with an increase in basis metal protection. This is probably due to cathodic control of the amount of nickel corroded according to the reaction

$$Ni \rightarrow Ni^{++} + 2e \text{ (anodic)}$$
$$2H^+ + \tfrac{1}{2}O_2 + 2e \rightarrow H_2O \text{ (cathodic)}$$

The amount of nickel corroded (mils penetration X per cent area corroded) is the product of time and a corrosion rate constant when the area corroded exceeds 10 per cent. The corrosion rate constant of the CASS test is around 375 mil-per cent per year, and that of Detroit service, 0.7 mil-per cent per year.

INTRODUCTION

THE CORROSION RESISTANCE of chromium electrodeposits has made it an important metal for maintenance of appearance of decorative plated surfaces. One of the earliest, and still best, uses for chromium was nickel tarnish prevention, for which only a thin adherent chromium layer was necessary. The importance of the chromium overlay on the basis metal corrosion protection afforded by the plating on automotive exterior trim has been only recently realized. Over 30 years ago, Baker and Pinner,[1] using results from the neutral salt spray test, recommended chromium of minimum discontinuities. This criterion has been virtually unchallenged in the past. Work on the problem has been hampered by lack of a reliable accelerated corrosion test. The recent adoption of the CASS[2] (copper chloride modified acetic acid salt spray) test expedited the development of dual chromium,[3] which has greatly reduced basis metal corrosion in service. A study of dual chromium revealed that better basis metal protection is associated with a pronounced increase in the number of discontinuities in the chromium.

This paper is a progress report of some recent work on the influence of chromium defects on corrosion. The CASS test was used to determine the relationship of the nickel area exposed through chromium discontinuities to the nickel corrosion and the nickel penetration rates. These results were compared with similar data obtained by microscopic measurements on service parts up to 21 years old. From CASS test results a corrosion mechanism was derived to explain the influence of exposed nickel area on nickel penetration.

*Research Laboratories, General Motors Corporation, Warren, Michigan.

EXPERIMENTAL

1. Chromium Plating

Two types of basis panels were used: (a) wrought nickel buffed (type A), 3 by 4 inches, and (b) steel panels 3 by 4 inches uniformly plated (by Apollo Metals Inc., Chicago) with 0.1 mil (1.0 mil = 0.001 inch) copper, buffed, followed by 1.0 mil Watts nickel, buffed. The panels were washed in acetone, cathodically cleaned one to two minutes in alkaline cleaner at 140F, rinsed, and then chromium plated. Four-gallon conventional baths (32–36 oz/gal CrO_3, 70–110:1 CrO_3/H_2SO_4, 110–120F, 1 amp/sq in.) were used. Plating was done with the cathode enclosed in an open-ended plastic

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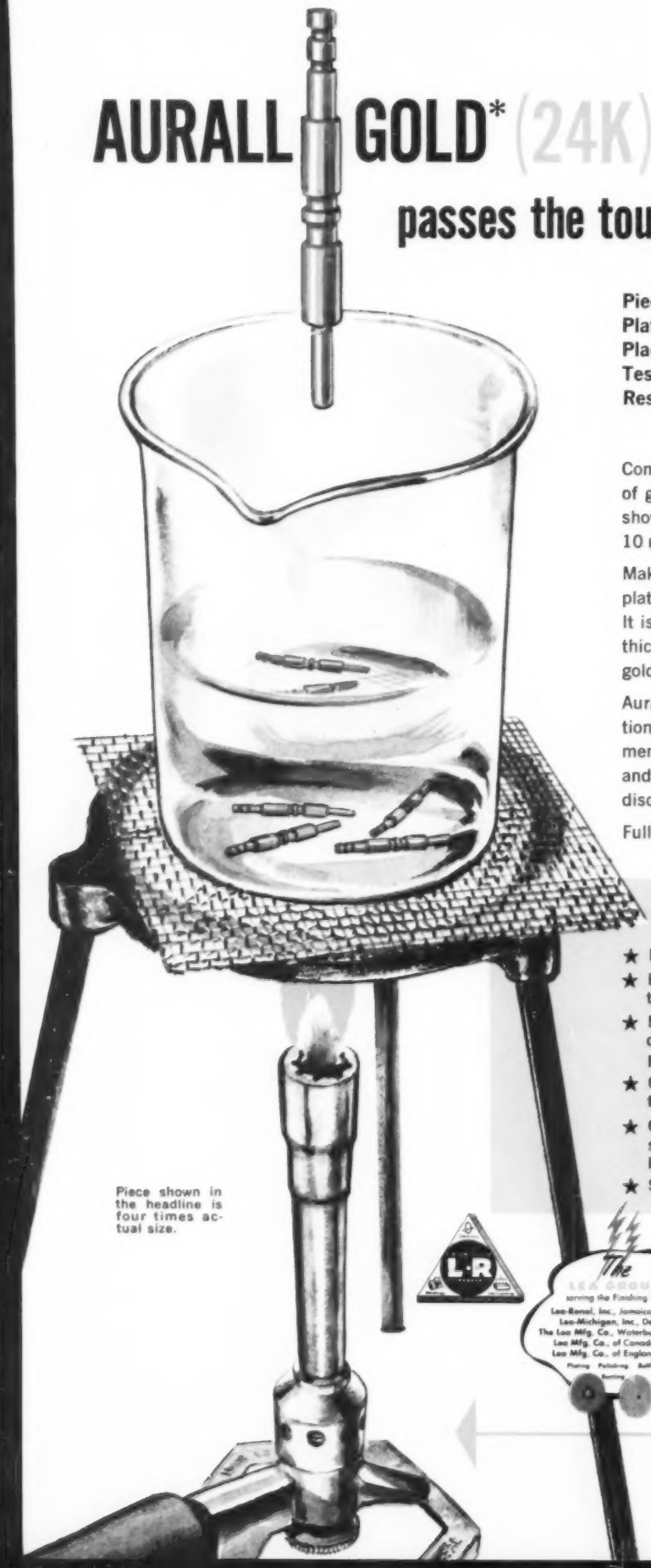

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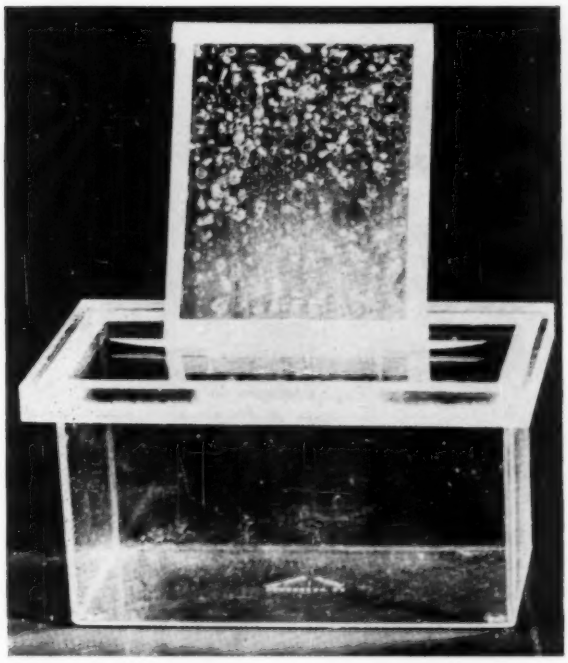

Fig. 1. Masked panel mounted on runoff collection box for corrosion test in CASS. This panel has already been exposed 48 hours, giving the many visible rust sites.

box (half-box[2, 4]) to insure uniform plate distribution at least within measurement accuracy.

2. Chromium Thickness Measurement

A strip of tape* was applied to the chromium plated surface with the edge on the desired location of thickness measurement. The taped edge location was immersed in five per cent $K_2Cr_2O_7$ solution and the chromium removed anodically (6 to 9 volts); the nickel was essentially unattacked. Chromium thickness was then measured with an interference microscope at the chromium-nickel boundary using white light[5] to determine fringe order and monochromatic light[6] to determine fractional order fringe displacements. Accuracy was ± 0.002 mil.

For chromium thickness less than 0.010 mil, modification of an interferometric technique[7] was used. In place of the transparent microscope cover glass, a small 95 per cent reflective mirror was placed on the metal specimen to form fringes. The fringe width was thus reduced considerably, enabling an ultimate sensitivity of 0.0001 mil.

3. Selective Chromium Removal

Research with dual chromium[3] had shown that increased durability was associated with an increase in number of chromium imperfections. It was desirable to know whether the imperfections, and not some other attribute of the dual chromium layer, were bringing about basis metal protection. The method of simulation of chromium imperfections was as follows:

> Many of the panels were plated with near impervious chromium (thickness 0.01–0.02 mil). Then some of the nickel was re-exposed by selectively dissolving the chromium, leaving either a surface of small nickel (or chromium) dots uniformly distributed in a chromium (or nickel) surface, or a series of alternate nickel and chromium stripes. The technique was as follows: A solution of an organic light-sensitive material** was sprayed onto the chromium plated specimen and allowed to dry. A dot- or line-pattern transparency*** was laid on the film and exposed to a given amount of light. This treatment altered the exposed areas of the surface film sufficiently to withstand a subsequent organic solvent (trichloroethylene) which dissolved the unexposed portion. The specimen with the organic film pattern was then subjected to 1:1 HCl solution, which dissolved the exposed chromium with little or no visible nickel attack, after which the remaining organic film was removed with a different organic solvent.**** The dot diameter (or the line width) and the distance between centers of the dots (or lines) were measured microscopically. The (deliberately) exposed nickel area could then be easily calculated; it varied from 8 to 100 per cent of the total surface area. The distance between dot or line centers varied with different panels from 0.01 to 0.08 inch.

4. Collection and Analysis of CASS Solution

A well known technique for corrosion study is weight loss of specimens of the desired metal. A more direct method, and in this case probably more precise and therefore to be preferred, is determination of the amount of nickel in the CASS runoff collection.

The back and edges of the panels were masked† leaving an exposed area of 2⅝ by 3⅝ inches (9.5 square inches). After cleaning the metallic coatings with magnesium oxide slurry, test panels were exposed in CASS; they were visually rated for rust every 24 hours.

The CASS runoff solutions were accumulated in plastic boxes, the covers of which also served to hold the specimens at 30 ± 5 degrees from the vertical (Fig. 1). The drops of spray solution that fell on a test surface flowed into its box through a hole in the specimen-holding slot. The accumulations, collected after 48 hours, and again after 96 hours, varied in volume between 40 and 120 cubic centimeters. Before analysis the solutions were filtered to remove solids, such as flakes of chromium, that may have become detached from the surface due to corrosion of underlying nickel.

Nickel analysis was by X-ray fluorescence[8] on the runoff solution without further treatment (sensitivity about 0.01 milligram per milliliter). Chromium was analyzed by a photometric diphenylcarbazide method[9] (sensitivity about 0.00005 milligram per milliliter).

Since analysis showed the second 48-hour collections to give nickel runoff values equivalent to the corresponding first 48-hour collections, the second 48-hour collection analysis results were not reported.

5. Measurement of H^+ Depletion

It was found that the *p*H of the runoff collection increased over that of the as-prepared CASS solution. The extent of

*3M No. 470.
**Eastman Kodak Photo Resist.
***Zip-A-Tone, manufactured by Para-Tone Company, Inc., Chicago, Illinois.
****Eastman Kodak Photo Resist Dye.
†Masked with 3M Tape No. 470.

H^+ depletion was measured in an attempt to determine the corrosion mechanism.

Depletion of acidity in the CASS solution collection was determined by back titration with 0.1N HCl to a *p*H of 3.10 (the *p*H of CASS spray collected on glass panels inserted in the plastic box covers was 3.2 ± 0.1) using a *p*H meter.*

6. Measurements of Production Parts in Service

The CASS test had enabled the postulation of a corrosion mechanism by which chromium imperfections could influence time to basis metal failure. However, a similar mechanism had not yet been demonstrated for service exposure. Accordingly, a number of parts were removed from cars in a scrap lot near Detroit, Michigan, during the first three months of 1961. Since the weight of nickel in the runoff could not be directly measured, the volume of nickel corroded was calculated from measurements of per cent area corroded and of penetration. Accordingly, after stripping the chromium from the desired area, as in (2) above, the per cent area of corroded nickel for these parts was measured, both on areas exhibiting no basis metal failure and on areas showing basis metal corrosion. Stripping was necessary as the chromium was often undercut by nickel corrosion. A microscope equipped with a movable crosshair eyepiece was used to determine the per cent of the area corroded as follows:

> The magnification was adjusted so that the visible field contained many nickel corrosion sites, yet so that they were sufficiently large to be easily measured. Where corrosion was in cracks, the lengths of the reticle straight line falling on corrosion sites were determined. The sum of these lengths, in per cent of the total line length, was the per cent projected surface area corroded.† Where the corrosion was in pit form, the average diameter of each corrosion site was measured and its area determined; the per cent area corroded was the ratio of the summation of corrosion areas times 100 to the measured area of the field. At least two representative locations per specimen were measured.

Thicknesses of copper and nickel, and average nickel corrosion penetration, were measured microscopically at 500× on the cross sections at the same location that the corrosion area and the chromium thickness measurements were made.

*Beckman Model G pH meter.

†On photographs of such surfaces, comparison was made between the above lineal analysis technique and an analysis technique based on area measurements.[10, 11] Results indicated the methods to be of comparable accuracy. The linear technique gave somewhat better precision, was faster, and was much less tedious.

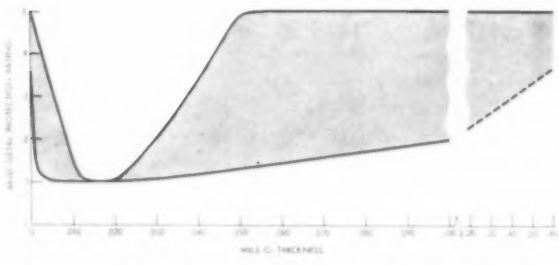

Fig. 2. Basis metal protection (48 hours CASS) vs. chromium thickness.

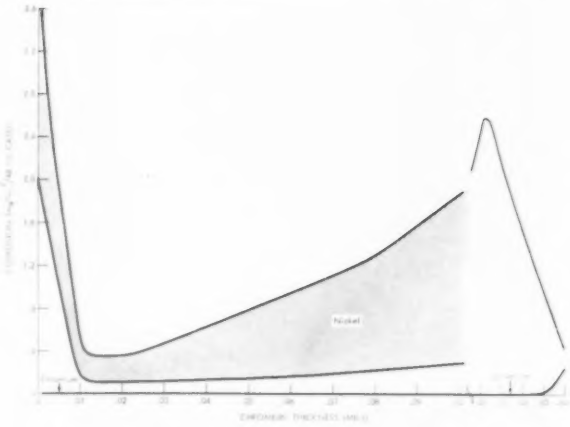

Fig. 3. Nickel and chromium corrosion in CASS vs. chromium thickness.

EXPERIMENTAL RESULTS

A. Influence of Conventional Chromium Thickness

In Fig. 2 is shown the relationship of basis metal protection rating to chromium thickness. Ratings ranged from "5" (no rust) to "1" (more than 70 per cent of the surface area affected by basis metal corrosion). Bands were used to indicate spread of ordinate data. The durability rating, usually "5" but never less than "4" for Apollo panels not chromium plated, decreased to a minimum as chromium thickness increased to 0.005 mil and remained at the minimum to 0.020 mil thickness. It then increased to a maximum. Microscopic observation showed that below 0.005 mil thickness good durability was associated with *pit* imperfections in the chromium. Above 0.020 mil, protection increase was associated with an increase in chromium *cracking*.

In Fig. 3 is shown the manner in which nickel and chromium corrosion vary with chromium thickness. Corrosion of bare nickel panels was 3.0 ± 1 milligrams per square inch for 48 hours CASS. The nickel was gradually covered as the overlying chromium thickness increased to 0.010–0.020 mil, evidenced by the decrease in nickel corrosion. With further increase in chromium thickness visual cracking occurred, associated with an increase in nickel corrosion to a maximum. The thickness at which the maximum occurred, indicated in Fig. 3 at 0.200 mil, might vary considerably from bath to bath, though in the author's experience it never occurred at a thickness less than 0.200 mil. Nickel corrosion then decreased above this thickness.

The band indicating range of nickel corrosion was not used above 0.100 mil chromium thickness as the relationships between nickel and chromium corrosion would not then be as clearly presented; a representative curve was drawn instead.

Chromium corrosion remained below detectability (below approximately 0.00005 milligram per square inch for 48 hours CASS) until a thickness well above ordinary decorative thicknesses was reached corresponding to a position well down on the second decrease on the nickel corrosion curve; chromium corrosion then increased rapidly with thickness. The analysis results showed that chromium corroded as the Cr^{+3} ion. Traces of Cr^{+6} ion found were attributed to plating solution retained by the deposits (probably in cracks), since thorough

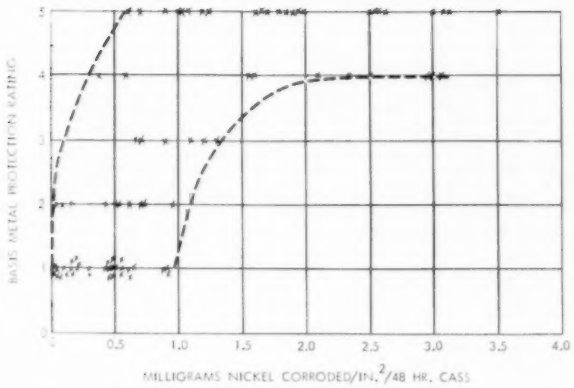

Fig. 4. Basis metal protection vs. nickel corrosion (Apollo panels plated with conventional chromium thickness between 0.0005 and 0.200 mil).

rinsing prior to testing removed all measurable chromium Cr^{+6} ion.

Comparison of Figs. 2 and 3 showed a direct relationship between basis metal protection and nickel corrosion at a chromium thickness up to that corresponding to the maximum nickel corrosion (0.200 mil in Fig. 3). This relationship can be seen in Fig. 4. Approximately 1.5 milligrams nickel per square inch per 48 hours CASS test is the indicated minimum for reliably good basis metal protection.

Similar experiments with panels plated with dual chromium gave nickel corrosion values near two milligrams per square inch per 48 hours CASS.

B. Influence of Exposed Nickel Area on Total Nickel Corrosion and on Basis Metal Protection

It has already been reported[2] that if the chromium, on a panel which ordinarily exhibited basis metal corrosion in only a few hours in CASS, was partially removed in small areas over the surface, the time to basis metal failure could be greatly increased.

This was studied by varying the per cent nickel exposed by means of the selective chromium removal technique and determining the amount of nickel corroded in the CASS test for a 48-hour interval by the collection and analysis technique. Figure 5 illustrates this data; the panel preparations are given in the figure. None of the bare Watts nickel plated panels showed basis metal protection ratings less than "4".

With chromium of few defects, rapid nickel corrosion penetration occurred, which on steel basis (Apollo) panels meant early steel corrosion. Therefore, only solid wrought nickel panels were used with as-plated chromium so that the total corrosion could be measured by runoff analysis for nickel.

No significant change can be seen in amount of nickel corrosion with an exposed nickel area above 10 per cent; in this range corrosion occurred at about 3.0 ± 1.0 milligrams per square inch per 48 hours CASS. Variation in distance between dot centers from 0.01 to 0.08 inch on the specimen surface did not measurably affect either the amount of nickel corrosion or the basis metal protection.

An unsuccessful attempt was made to replace the conductive (chromium) with a nonconductive film overlay to see if the amount of nickel corroded would then vary directly with area as might be expected. In order to retain the same experimental setup, the pattern resist itself was used. It was sprayed onto the nickel and a pattern developed, after which it was baked thoroughly to reduce its solubility and chemical reactivity. It was then exposed in the CASS test and runoff collections made in the usual manner. These data, also included in Fig. 5, suggest that the corrosion of the nickel partially covered by an organic resist pattern was also independent of wide nickel area variation. The nickel under the organic film was not visually corroded. However, it was discovered that the organic film had become conductive, suggesting that it allowed the cathodic reaction to proceed just as with a chromium overlay. This intimates that any non-corroded conductive overlay film would also act in a similar manner.

C. Study of Protective-Decorative Chromium Plating on Automobiles

Pertinent data are shown in Table I. No areas were seen on the automotive parts in service on which the surface was free of corrosion defects. However, all parts listed exhibited an area of no visible basis metal failure, labeled "good". Defects on such areas were usually cracks resulting from nickel dissolution under what were apparently chromium cracks. Most parts also exhibited areas of visible basis metal failure, labeled "failed". Such failure almost invariably occurred through pit-type defects. The chromium surface remaining was still "full-bright," intimating that general chromium surface corrosion did not occur.

Since the "failed" area cross sections exhibited a significant number of complete nickel penetrations (more than four per lineal inch on the cross section), their penetration measurement was omitted. Penetration measurements for some of the "good" areas were omitted for the same reason. Data inspection shows that better basis metal protection and lower nickel penetration were usually associated on a given part with a greater per cent corroded nickel area. In many cases basis metal protection was also associated with increased thickness of nickel, and also of chromium, although the influence of chromium was probably not through its thickness per se, but through its defect density as determined by its thickness.

The data also indicate that the minimum exposed nickel area for absence of visual basis metal corrosion was some-

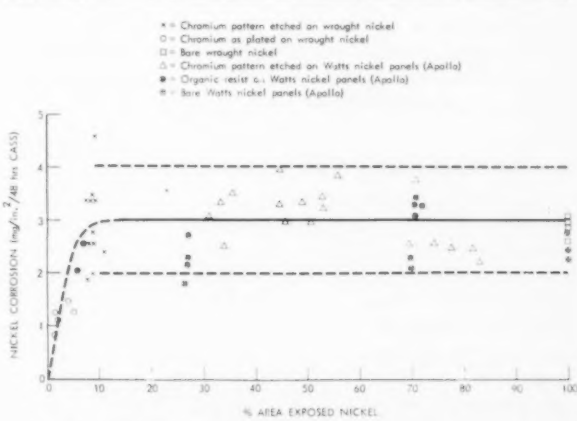

Fig. 5. Nickel corrosion vs. per cent area nickel exposed after 48 hours CASS.

TABLE I

DATA FOR PARTS IN SERVICE

Part	Basis Metal	Condition of Location	Thickness (Mils) Copper	Nickel	Chromium	P = Average Nickel Penetration, Mils	A = Per Cent of Area Corroded	PA*
1940 Buick Front Bumper Guard	Steel	Good	0	1.80	0.080	0.56	22.7	12.7
1940 Buick Front Bumper Guard	Steel	Good	0	3.68	0.090	0.50	31.1	15.5
		Failed	0	1.17	0.040	—	42.7	—
1947 Buick Hood Latch	Die Cast	Good	0.32	0.95	0.008	0.46	17.2	7.9
		Failed	0.15	0.80	0.011	—	7.5	—
1947 Buick Hood Ornament	Die Cast	Good	0.79	1.51	0.050	0.46	16.5	7.6
		Failed	0.29	0.62	0.017	—	2.4	—
1949 Buick Hood Ornament	Die Cast	Good	0.48	1.40	0.016	—	2.4	—
		Failed	0.40	0.80	0–0.020	—	0.6	—
1950 Cadillac Rear Bumper Guard	Steel	Good	0.94	1.39	0.020	—	7	—
1950 Chevrolet Door Handle	Die Cast	Good	0.54	1.36	0.025	—	4–6	—
		Failed	0.48	1.21	0.017	—	below 1	—
1950 Cadillac "V" Rear Ornament	Die Cast	Good	0.46	0.99	0.015	—	5	—
		Failed	0.50	0.51	0.015	—	2	—
1950 Buick Hood Ornament	Die Cast	Good	0.46	1.17	0.035	0.75	10	7.5
		Failed	0.51	1.03	0.030	—	below 1	—
1950 Pontiac Door Handle	Die Cast	Good	0.08	2.22	0.025	0.53	16–19	9.3
		Failed	0.10	1.17	0.013–0.020	—	7	—
1950 Buick Door Handle	Die Cast	Good	0.13	1.87	0.025	0.25	25–42	8.4
1950 Buick Grille Guard	Steel	Good	1.23	1.72	0.040	0.34	23	7.8
		Failed	1.08	0.43	0.008	—	5	—
1951 Kaiser Rear Bumper	Steel	Good	0	1.74	0.023	0.32	20	6.4
		Failed	0	0.83	0.020	—	4	—
1954 Buick Front Bumper Guard	Steel	Good	1.73	0.68	0.006	—	2.1	—
1954 Buick Headlamp Bezel	Die Cast	Good	0.84	1.05	0.020	None on section	0.5	—
1955 Buick Front Bumper Guard	Steel	Good	3.36	1.08	0.023	0.33	12.8	4.2

*PA × 10^{-4} = cubic inches nickel corrosion per square inch of surface.

where between five and ten per cent after eleven years' service. Some overlapping of per cent area for failure on one part and no failure on another part might have been, in part, due to difference in car maintenance or in corrosion conditions.

The copper deposit, once exposed, was often penetrated much more rapidly than nickel as was noticed on the cross sections where the copper was corroded below apparently intact nickel. In some specimens there was very little or no copper, also indicating that its presence may not be necessary in order to achieve good basis metal protection.

D. Nickel Corrosion Mechanism in CASS

Figure 6 is a plot of millimoles of nickel corroded against the millimoles of H^+ necessary to reduce the CASS collection *p*H to the original value of 3.1. The dotted line represents an average of the data plots, and the solid line represents the theoretical plot showing use of two hydrogen ions for every nickel ion produced. It is evident that, for all practical purposes, two hydrogen ions were consumed for every nickel atom corroded. The *p*H value for the solutions as collected varied from 4 to 6.

This was repeated, but by immersion in CASS solution instead of CASS spray. Two-by-four-inch wrought nickel

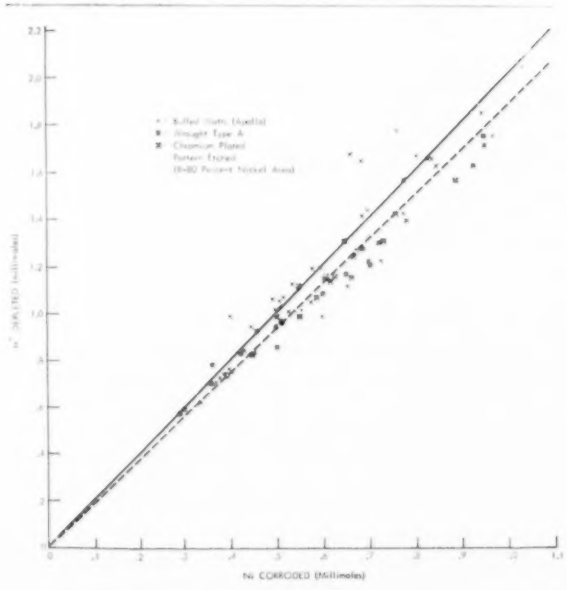

Fig. 6. H^+ Depletion vs. nickel corrosion.

panels were immersed 16 hours with a gas (oxygen, air, or as-received tank nitrogen) bubbling through 50 cubic centimeters of CASS solution. Although only a few panels were so tested, two hydrogen ions were required for every nickel atom corroded. It was found in addition that much less corrosion occurred with nitrogen gas alone, suggesting that oxygen may be necessary for nickel corrosion in CASS solution, and therefore possibly in the spray chamber. The fact that the CASS test predicts outdoor performance[2] implies the same corrosion requirements outdoors.

DISCUSSION

The near absence of basis metal corrosion for the as-received nickel-plated steel (Apollo) panels after CASS exposure is evidence that there were few pores in the nickel deposit as prepared. The presence of numerous basis metal corrosion sites on the chromium plated specimens after CASS exposure indicates, therefore, that nickel has been penetrated by the corrosion process. The presence of nickel ion (Ni^{++}) in solution runoff is also evidence of this corrosion. Therefore, a corrosion mechanism leading to basis metal corrosion must include the reaction

$$Ni \rightarrow Ni^{++} + 2e \quad \text{(anodic)}.$$

A cathodic reaction is necessary to consume the electrons released. The fact that two hydrogen ions are consumed for every nickel ion produced, and that limited evidence indicates oxygen to be necessary for the above reaction to take place, suggests that the other reaction is oxygen reduction

$$2H^+ + 1/2O_2 + 2e \rightarrow H_2O \quad \text{(cathodic)}.$$

If, as the evidence suggests, the per cent exposed nickel area above a certain minimum does not influence the total corrosion rate, then by inference, the cathodic reaction must be controlling. Electrical measurements with immersed panels[3] have also shown that the amount of chromium area, and not that of nickel, usually determines the corrosion current. Cathodic control may be due either to formation of a surface film (possibly nickel hydroxide resulting from the *p*H increase) thus restricting H^+ access to the metal, or to limiting oxygen diffusion. Lack of data precludes much further speculation on this.

For as-plated chromium surfaces, the exposed nickel area is very low—probably below one per cent. (By "exposed" nickel is meant that nickel which is wet by the corrosion medium.) During corrosion the nickel area exposed increases. For good basis metal corrosion protection, it seems reasonable to conclude that the increasing per cent nickel area exposed should reach a certain minimum (around 10 per cent), so that the cathodic reaction limits the nickel corrosion rate before nickel perforation occurs.

This implies that a certain minimum chromium imperfection density* is beneficial. This principle of corrosion protection has been substantiated by determinations of per cent exposed area of nickel at locations of no basis metal corrosion for both CASS and service specimens. It has also been supported by comparison of values of total nickel corroded (analysis of runoff from CASS exposure, and corroded volume measurements for service parts) with those of nickel penetration and time to basis metal failure. As nickel under either decorative chromium (selectively etched, conventional untreated, or dual) or an (conductive) organic film pattern exhibits comparable corrosion behavior, this suggests that the above hypothesis applies to any film on nickel which has penetrating defects and allows conduction but does not itself measurably corrode.

Below 10 per cent area, the rate-limiting reaction possibly shifts to the anodic reaction. It is probably not due to ion flow restriction through narrow chromium defects, as specimens with as-plated chromium (such as dual chromium) on which the defects are very narrow also give nearly the maximum amount of nickel corrosion.

The presence of chromium corrosion at chromium thicknesses greater than 0.500 mil (Fig. 3) hints that chromium can corrode in the near absence of nickel, at least in the CASS test. This was verified by exposure of electroformed chromium sheet. Such corrosion was probably uniform; the surface lost luster and the amount of Cr^{+3} found was quite large. (No Cr^{+6} attributable to corrosion was detected.)

It is interesting that as chromium thickness increased above 0.020 mil, the exposure of the underlying nickel by corrosion was often *increased*. The lack of this knowledge in the past (and often the assumption of the opposite) could probably account for many unexplainable anomalies in basis metal protection of specimens prepared "identically."

The inability to collect runoff from service parts was circumvented by measuring the average penetration and the per cent corroded area. Their product was assumed to be an approximation of the volume of nickel corroded. If radial corrosion from the chromium defect into the nickel is assumed, then the following relationships can be developed.

Pits

$$V = \frac{4}{3}\pi r^3 \times \frac{1}{2} \text{ (hemispherical)}$$

V = volume of nickel corroded
A = measured projected area = πr^2
P = measured penetration = r

$$V = 0.67\ PA$$

Cracks

$$V = \pi r^2 L \times \frac{1}{2} \text{ (semicylindrical)}$$

L = crack length
A = 2 r L
P = r

$$V = 0.79\ PA$$

Since pit bottoms beneath narrow chromium defects were almost invariably hemispherical, V = 0.67 PA was considered a minimum limiting case. The maximum limiting case was a flat-bottom pit which was often approximated when chromium did not remain in situ during underlying nickel corrosion, when V = PA. Therefore, it is reasonable that $0.67\ PA \leqq V \leqq PA$ would apply to all cases. Since penetration and area measurements were approximate, nickel loss due to corrosion was calculated on the assumption that

*A minimum permissible crack density can be calculated as follows: For nickel 0.001 inch thick, and assuming semicylindrical nickel corrosion under a narrow chromium crack, the corroded area must increase to 10 per cent by the time nickel penetration occurs, or

$$\frac{2r}{s} = 10 \text{ per cent}$$

$$\frac{0.002 \text{ inch}}{s} = 0.10$$

r = radius of corrosion beneath crack
s = distance between cracks

s = 0.02 inch maximum separation or 50 cracks per inch minimum necessary for good basis metal protection under 0.001 inch nickel.

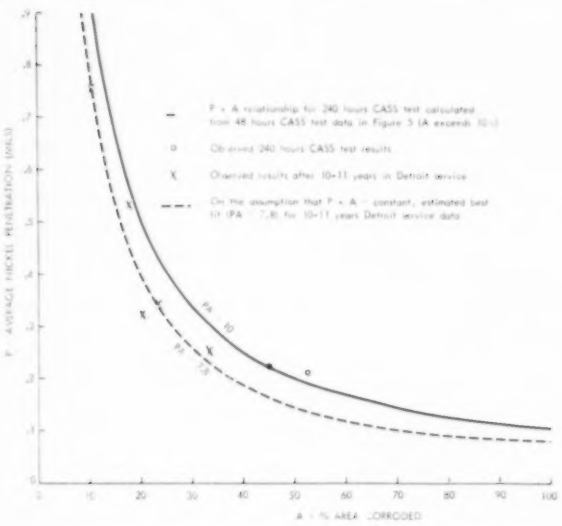

Fig. 7. Nickel corrosion penetration vs. per cent area corroded.

V = PA. Assuming a chromium plated surface area of one square inch, the portion of the area corroded multiplied by the average penetration in inches would be the approximate volume in cubic inches of nickel corroded per square inch of surface area. In this report, P is reported in mils penetration and A in per cent area corroded, thus making the resultant calculated volume, V, referred to in this report as mil-per cent, larger by a factor of 10^5 than the actual (approximated) volume of nickel dissolved in cubic inches per square inch of surface.

Data from the CASS test have already been presented (Fig. 5) suggesting that above a minimum per cent nickel area (about 10 per cent), the total amount of nickel corroded is a constant for a given time. This was also tested for the outdoor data (Table I). For the 1949 and 1950 parts, where the per cent area corroded was above 10, it may be seen that PA is in fact a constant within reasonable limits—7.8 ± 1.8 mil-per cent.

Since nickel penetration values are of governing significance, a graph of penetration versus per cent area corroded is shown in Fig. 7, utilizing available data from both service exposure and CASS testing. The upper (solid) curve was calculated from CASS data obtained by runoff analyses. The average nickel corrosion above 10 per cent area (as shown in Fig. 5) was 3.0 milligrams per square inch per 48 hours CASS. Since it remained essentially unchanged for two 48-hour periods, it was assumed to remain constant for 5 periods, or 240 hours. Accordingly, this corrosion rate was converted to 0.103-mil penetration in 240 hours CASS for 100 per cent nickel area.* Since P (0.103 mil) × A (100 per cent) = 10, the curve PA = 10 was plotted. The two data points were obtained from measurements of penetration and per cent area corroded on production parts exposed in fact for 240 hours in the CASS test. These data lie close to the curve derived from runoff analysis measurements, suggesting that the V = PA approximation is reasonable, and that the assumption of a constant nickel corrosion rate for each of five 48-hour periods is valid for a sample with nickel area over 10 per cent. Incidentally, the only visible deterioration of these two dual-chromium plated parts was a slight unobjectionable increase in haze.

The PA product for the lower dotted theoretical curve was made equal to 7.8 to best fit the data of the 10- and 11-year old parts. It is seen that the fit above 10 per cent corroded area is good.

Complete nickel penetration in areas with less than 10 per cent exposure occurred at some unknown time; therefore, no data were available to test the decrease in nickel corrosion anticipated by CASS data (Fig. 5), which fact in itself implied that 10 per cent nickel area was necessary to obtain good basis metal protection for 10 years. It would be reasonable that the penetration rate below 10 per cent corroded area would continue to increase with corrosion area decrease, though perhaps not so rapidly as the PA curve, until the chromium defect size was sufficiently small to keep out the corrosion medium. Below this, the nickel penetration rate must decrease to zero, since there could be no nickel corrosion with no nickel available.

Figure 8 shows PA products of Table I plotted against years of service in the Detroit area. Data from "good" specimens with corrosion area over 10 per cent were used. It is seen that a straight line passing through the origin can represent an average of data points.

Let the equation for the straight line representing average observed performance be (PA) = kt where "P" is nickel penetration in mils, "A" is per cent area corroded, "k" is a corrosion rate constant, and "t" is exposure time. Then, for Detroit service, k = 0.70 mil-per cent per year.

A similar calculation using CASS test data gives the corrosion rate constant,

$$k_{CASS} = \frac{0.103 \text{ mil}}{240 \text{ hours}} \times 100 \text{ per cent} \times 8750 \text{ hours/year} = 375$$

mil-per cent/year.

The ratio of the CASS test corrosion rate constant per year to that for Detroit service is, therefore,

$$\frac{k_{CASS}}{k} = \frac{375}{0.70} \simeq 535.$$

It follows that one year of Detroit service is equivalent to

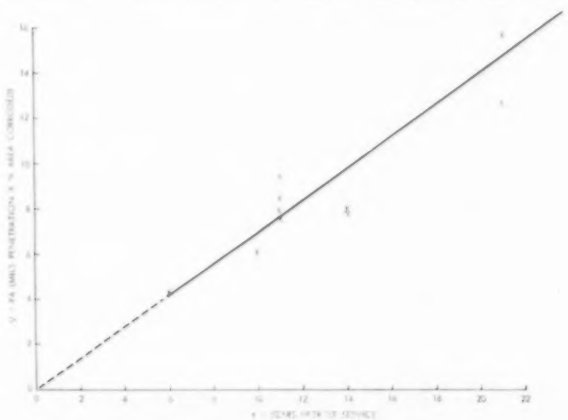

Fig. 8. Volume of nickel corroded on automotive trim vs. years Detroit service.

*$0.003 \text{ g/in.}^2 \times \frac{1 \text{ cm}^2}{8.9 \text{ g.}} \times \frac{1 \text{ in.}^2}{16.4 \text{ cm}^2} \times \frac{240 \text{ Hours CASS}}{48 \text{ Hours CASS}} = 0.000103$ inch nickel removed in 240 hours CASS.

8750/535 ≃ 16 hours in the CASS test. This is in fair agreement with, and hence tends to support, the currently used arbitrary judgment based on observation that 16 to 24 hours CASS is equivalent to a year of service in the Detroit area.

Further, for uniformly corroding nickel not chromium plated, it follows that the average penetration rate per year in the CASS test is 3.75 mils (375 mil-per cent ÷ 100 per cent) while the annual penetration rate for bare nickel electrodeposit in Detroit service should average 0.0070 (0.70 mil-per cent ÷ 100 per cent).

Published penetration, or, more properly, metal dissolution, rates for nickel[12] are:

in CASS	2.8 mil per year
in industrial environment (New York City)	0.15 mil per year
in rural environment	0.01 mil per year
in marine environment	0.01 mil per year

It can be seen that the CASS test results are in fair agreement. The penetration rate listed for an industrial exposure is appreciably higher than that for the other outdoor environments listed; corrosion acceleration in such environments is already recognized, even to the extent that some sites close to heavy industry have been used for accelerated corrosion testing. It is also seen that the calculated dissolution rate of nickel in Detroit area service, which includes many heavy industries, is not greater than, as perhaps expected, but is essentially equal to, that found in marine and rural atmospheres. Assuming the data are correct, then perhaps average owner maintenance, including garage storage and an occasional car washing, keep the plated surfaces sufficiently dry and clean to nullify some of the effects of exposure in a highly corrosive location.

In conclusion, the following points can be stated:

1. On chromium over nickel electroplate, the CASS test is further verified as a corrosion test for basis metal protection representative of industrial-urban environment. Nickel corrosion measurements indicate 16 hours CASS to be equivalent to one year metropolitan Detroit exposure. This correlation appears valid for a time interval of at least 20 years outdoors.
2. A corrosion mechanism has been experimentally determined for the chromium over nickel system in CASS.
3. The above corrosion mechanism has been used to explain how a greater concentration of chromium defects exposing underlying nickel can increase the time to basis metal corrosion by a factor of ten. The effect of variations in exposed nickel area on the total nickel corrosion rate and on the nickel penetration rate obviates unexplained results by others in the past.
4. If the chromium crack pattern is uniform and sufficiently small, all that is seen even after 240 hours CASS is a slight increase in haziness which is uniform over the surface, and therefore almost completely unobjectionable.

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RECENT DEVELOPMENTS IN STEEL CONTAINER PROTECTIVE LININGS

by HUGH EDWARDS*

IT IS NOT THE INTENT of this paper to belabor or further extol the virtues of the very popular high bake modified epoxy or phenolic linings, or of the oleoresinous and solution vinyl coatings. These have quite a venerable history and will continue to be with us for many years. All of the aforementioned coatings will continue to serve industry if for no other reasons than their economy of manufacture and their formulation from readily available raw materials. Above all, their relative ease of application by almost any number of methods such as hot or cold air or airless spray, direct or reverse roller coating, curtain coatings, slushing, dipping, etc., make the use of these coatings so widespread.

Yet the never ending search for new types of linings and coatings continues. It is these newer types of coatings that will be discussed.

1. Organosol and plastisol drum linings are among the newer types of finishes currently being used. They are also known as vinyl dispersion coatings to be differentiated from vinyl solution coatings. The former require adhesives and can be applied at heavier film thicknesses from 0.004 to 0.020 inch. Vinyl dispersion coatings for steel containers are however, at the present time, nothing in themselves without the proper adhesive or primer coats to go with them. The study and formulation of adhesives is, in itself, a recent and complicated science.

2. In the never-ending search for flexible phenolics, a specialty phenolic coating has been developed for the purpose of holding chemicals such as monoethanolamine and yet possesses adhesion and flexibility quite comparable to the modified epoxy coatings.

3. Of recent development has been the formulation of polyethylene dispersion coatings made from pure high density, high melting point, high durometer reading polyethylene. Primers have been developed so that they may be applied to tinplate as well, and currently show great promise for the bottle crown industry.

4. Polybutadiene coatings have been developed for use in can coatings to take high temperature cures and show great promise in the pail and drum container field.

VINYL DISPERSION COATINGS AND ADHESIVES

Before entering into a discussion on this subject, it would be very appropriate to state that the adhesive and vinyl dispersion coatings are to be considered as a system. Most consistent and best results are obtained when the vinyl

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dispersion coating is used with the adhesive designed for it. The primers or adhesives may be in the family of vinyls, phenolic-vinyl, epoxy-acrylic, epoxy-acrylic-vinyl, phenolic acrylic, etc.

The theory is fundamentally quite simple—a thermoplastic and thermosetting component. Each component may be composed of one or more resins together forming a thermoplastic or thermosetting component. During the curing operation, a striation of the film probably takes place with the thermoset portion going to the metal substrate, whereas the thermoplastic portion migrates to the surface. It is this upper portion which bonds with the dispersion coating by virtue of a limited compatibility. It is the thermoset portion which promotes the adhesion to the metal.

In view of the fact that vinyl dispersion lined drums are used predominantly in the packaging of aqueous systems, it behooves the supplier and user to employ a system offering the greatest possible water resistance. This can now be obtained by a recently formulated modified acrylic adhesive which affords greater water resistance, flexibility and adhesion. Curing schedules range from flash dry to ten minutes at 500F. Best overall properties are obtained at baking temperatures of 350–400F for ten to fifteen minutes. This adhesive is not sensitive to overbaking or to oven fouling, and in addition, provides such good adhesion and abrasion resistance that a minimum of touch-up is required after fabrication.

The vinyl dispersion system has been found to successfully withstand lactic acid, phosphoric acid, dairy cleaners, milk stone removers, many metal cleaners, cement hardeners, synthetic detergent, etc. It is not intended for the packaging of solvents, solvent type materials and similar items. The dispersion is applied to previously primed metal normally by air or airless cold spray or centrifugal spray to a film thickness of 4–10 mils applied in two coats.

The first coat is baked for fifteen minutes at 300F, and the second coat baked for fifteen minutes at 350–375F. Overbaking of the first coat can lead to delamination of coats especially if we are dealing with formulations of low levels of plasticizer content. Two coats of vinyl dispersion are the normal application simply because the products being packaged are quite reactive and the second coat covers up faults and flaws found in the first coat.

Vinyl dispersion coatings for containers can vary from 30 to 50 per cent in plasticizer content. The higher the plasticizer content, the softer the film and very usually the lower the chemical resistance of the film, especially at elevated temperatures of 120–140F. Plasticizer will tend to migrate from the film into the product especially at elevated temperatures. As the plasticizer leaves the film, it is replaced by the product which may be either an acid or detergent, and blistering with ultimate loss of adhesion results.

Organosols are normally lower in plasticizer content than plastisols, the difference in liquid being made up with solvent. It is for this reason that total solids of organosols are lower than plastisol. It is for the same reason that organosol films are applied thinner than plastisol films. However, because of greater chemical inertness, they can be used successfully in many cases where heavier plastisol films are used. Organosol films are usually applied in two coats at film thicknesses of 4 to 6 mils whereas plastisol films are applied in two coats 8 to 12 mils. Those plastisols having a high order of plasticizer content are usually applied 12 to 20 mils in thickness.

Very extensive tests conducted in the laboratory indicate a plasticizer level of about 30 per cent for plastisol is optimum affording the greatest protection at widest temperature variances. Such plastisols are applied at film thicknesses of 6 to 10 mils—two coats. Criterion for a valid vinyl dispersion for container coatings rests not solely on how heavy it can be applied, but rather how chemically resistant it is. Holding the product is most important.

An interesting fact of vinyl dispersion lined drums is that such lined drums can very frequently be used more than once and can consequently be used for the packaging of such low cost items as aqua ammonia very economically. Normally, it is not economical to ship such an inexpensive product in drums because the container cost is sometimes greater than the product. If the product is used up readily and more than one trip can be realized, packaging in drums can become a reality. It has been brought to my attention that some producers are getting as many as ten trips out of each drum for ammonium hydroxide.

One of the worst objections expressed against vinyl dispersion application has been the fog, or smog, resulting in the factory from the curing of such linings. In many locations of our country, such as in Los Angeles, this poses quite a problem for smog control. Smokeless plastisols have been developed and are currently being successfully used in these areas.

An interesting development has been the formulation of an F.D.A. approved plastisol which can be used for the packaging of food grade lactic and phosphoric acids and similarly related items. This type of lining is currently being sold and used in the container manufacturing industry.

In view of the fact that we are concerning ourselves primarily with aqueous products, usually of an acidic nature, it becomes necessary that the amount of exposed steel be kept down to the very minimum. This implies that pails be made and assembled similarly to drums. This is to say, shells, heads and bottoms are to be precoated prior to final assembly. Spraying pails or drums with vinyl dispersions after the container has been assembled is not recommended simply because it is not possible to coat down in the double seam area.

It is admitted that the percentage of vinyl dispersion lined drums is relatively small, but nevertheless, it has and is continuing to serve an important function in the packaging industry. It has definitely helped to augment the number of uses for steel drums. It is a fact that many items previously packaged in glass and wood have now found their way into a steel container lined with vinyl dispersion resins with all their consequent advantages (resale value, package rigidity and economy). There is no doubt that the number of such containers will continuously increase as the number and variety of different chemicals become available to our present society.

APPLICATION

The adhesive can be applied by roller coating (direct or reverse)—hot or cold spray (air or airless)—centrifugal, electrostatic.*

Plastisol and organosol have been applied by roller coating, conventional air spray and cold airless spray. Hot airless spray or heat in general should be avoided inasmuch as

*Gyromat or Ransburg.

gelling of the vinyl dispersion may result. Some manufacturing facilities have found it advantageous to increase the size of the fluid discharge openings from their spray equipment in order to deliver more material in a given time and to minimize the occasional clogging of the spray guns. By and large however, with the exception of the heat factor, plastisol and organosol applications have been, and are being, carried out on conventional spray type equipment.

I. Newer Developments

The search is going on at the present moment for vinyl dispersion coatings that can be applied directly to the metal without the use of adhesives. In the field of decorative coatings this has already been achieved and is known as a One Coat Organosol. The problem is now to formulate a One Coat Vinyl Dispersion System that will have the same chemical resistance properties as the one currently being used with an adhesive.

II. Flexible Phenolics

A great deal of effort has been and is still continuing to be devoted to develop phenolic coatings with a flexibility and adhesion that will be an improvement over what are commonly used. One development was a brown phenolic coating providing excellent alkali resistance but possessing slightly reduced solvent resistance. This is based on a Methylon* type of phenolic and requires a far higher bake than the conventional heat reactive phenolics. It is recommended for holding monoethanolamine, a very difficult chemical to hold. A double coat one mil thick, baked 475–500F, can withstand a reverse impact blow in excess of 60 in.-lb. It can be applied by spray or roller coat. First coat is baked fifteen minutes at 400–425F, and the second coat baked fifteen minutes at 480F. To maintain the high degree of reverse impact, a fully baked film should not be in excess of one mil thick.

Flexibilizing conventional phenolics can also be effected through the use of size coats. It is true that reverse impact is augmented by such a method. It is equally true that one sacrifices a lot of chemical resistance by such methods, as well as solvent resistance. This system may have its dubious position in the industry. The author is not above compromising, but believes one should know what one is compromising in such methods.

The size coats previously mentioned are vinyl phenolics applied in thin films and baked. The phenolic lining is now applied over the size coat. This lowered chemical resistance would probably not be very important when packaging fat and oil, but it can pose a serious problem when it comes to holding very active solvents and organic acids.

Extensive tests have shown that high baked epoxy-phenolics would be a much more satisfactory solution for many products currently being packaged in phenolics and yet providing the reverse impact, flexibility and adhesion desired.

III. Polyethylene

A very recent arrival on the lining scene has been polyethylene. It has long been known that polyethylene would adhere to steel when molten and kept in a molten condition at about 375–400F. But this, in itself, was not enough and consequently, the greatest use of polyethylene developed along lines of molded plastics and bags which, in reality, acted as a container within a container. Among the first chemicals so packaged in a metal container was battery acid.

It was not until finely divided polyethylene appeared on the market that anything could be done with polyethylene as a bona fide organic coating.

Originally, polyethylene was recommended for use directly over steel surfaces. Laboratory tests indicate that polyethylene over bare steel surfaces showed very little promise simply because of the relatively high order of moisture vapor transmissivity. Extensive laboratory work indicated that if polyethylene had anything to offer, it would have to be when applied over a previously high baked lining such as a pigmented phenolic or modified epoxy.

Polyethylene can be applied in either very thin or heavy films depending upon the type of service required. Thin film applications—one to two mils—are recommended in those cases where product release is important. The polyethylene applied to a high bake lining affords a slippage action so that the drum may be efficiently emptied of its contents with a minimum of waste.

Single coats—3–5 mils, or double coats—6–10 mils, may be applied where it is desirous of holding various concentrations of acetic acid, amines, inks or dyestuffs. Obviously, the greater the corrosive action of the product, the heavier the film of polyethylene required.

Baking schedules will vary between 400–450F for fifteen minutes depending upon the gauge of metal and type of substrate. Already such polyethylene coated containers have been made—both pails and drums and a tremendous interest is currently being generated. We feel sure that polyethylene lined containers will shortly establish a niche for themselves in the industry.

There are problems involved in the manufacture of such containers as for example:

1. Covers of open head drums should be cooled before assembly or they will adhere.
2. Warm parts should not be stacked or, again, they will be marred or adhere together.

Application can be by centrifugal or conventional spray. Fluid tips should be between 0.086 and 0.110 inch opening. Smaller openings will tend to create gun clogging problems. Screens and filters in fluid lines should be removed for the same reason.

Currently, activities are being directed toward the formulation of primers and adhesives for polyethylene as particularly it applies to the closure industry where attempts are being made to replace cork and plastisol with polyethylene.

IV. Polybutadiene

Currently undergoing evaluation studies are the polybutadiene coatings. It is an interesting outgrowth of development work in can coatings where it was desired to create a product that could be cured very rapidly over a hot solder bath 600–700F. Preliminary pack tests proved encouraging and further work is proceeding along these lines.

Because these resins are produced from readily available petroleum products, they are extremely economical to use and could probably be used in most cases where oleo resinous materials are currently being used today.

*Methylon—trademark registered by General Electric.

When cured at 400–500F, these materials exhibit excellent water resistance. An interesting characteristic of these materials is the ability to apply them at relative heavy film thickness with no blistering at high temperature.

Unfortunately, all the linings used in conventional pails cannot be used in tapered pails. For example, pigmented and clear phenolic coatings abrade off very readily. Soft oleoresinous materials abrade off as well. Rust inhibitors tend to lose their effectiveness when not closed in with covers with consequent rusting.

A great measure of success of the tapered pail however, has been due to the effectiveness of the modified epoxy phenolic coating. Both the clear and pigmented epoxy phenolic coatings have shown outstanding abrasion resistance. This, together with outstanding adhesion and flexibility and above all, great chemical resistance has allowed for the successful manufacture of tapered pails in this country. Indications are quite evident that this market will continue to expand.

This development has caused the container industry to take another good, cold look at the modified epoxy coating as a replacement for phenolics where, in addition to chemical inertness, a high degree of mechanical resistance such as abrasion, reverse impact and flexibility is needed.

Certainly this situation will be reached in the larger type container when shells are no longer made of 18 gage steel. Already many drums are fabricated from 20 gage steel and as the gage is further reduced, reverse impact properties will become still more prominent and as such, the epoxy coatings too will come into still greater importance.

WHAT OF THE FUTURE?

One of the greatest engineering changes in drum manufacture to come will be in the type and quality of ovens and time of curing. The trend has already made itself felt. There is no doubt but that the trend is for higher temperatures at reduced oven baking times. Reduced times in the oven for cure can enormously increase out-put. Already some coil coating lines are curing by induction heating. Such facilities are costly it is to be admitted, but the fact that already these ovens are here is of great significance. What now takes 15–20 minutes to cure will be accomplished in the future at times of from two to five minutes. Even now very efficient cyclone ovens are available that can cure pails in two-thirds the time normally required. Since heat transfer is involved in film curing, it is apparent that a greater heat transfer or BTU input can shorten curing times.

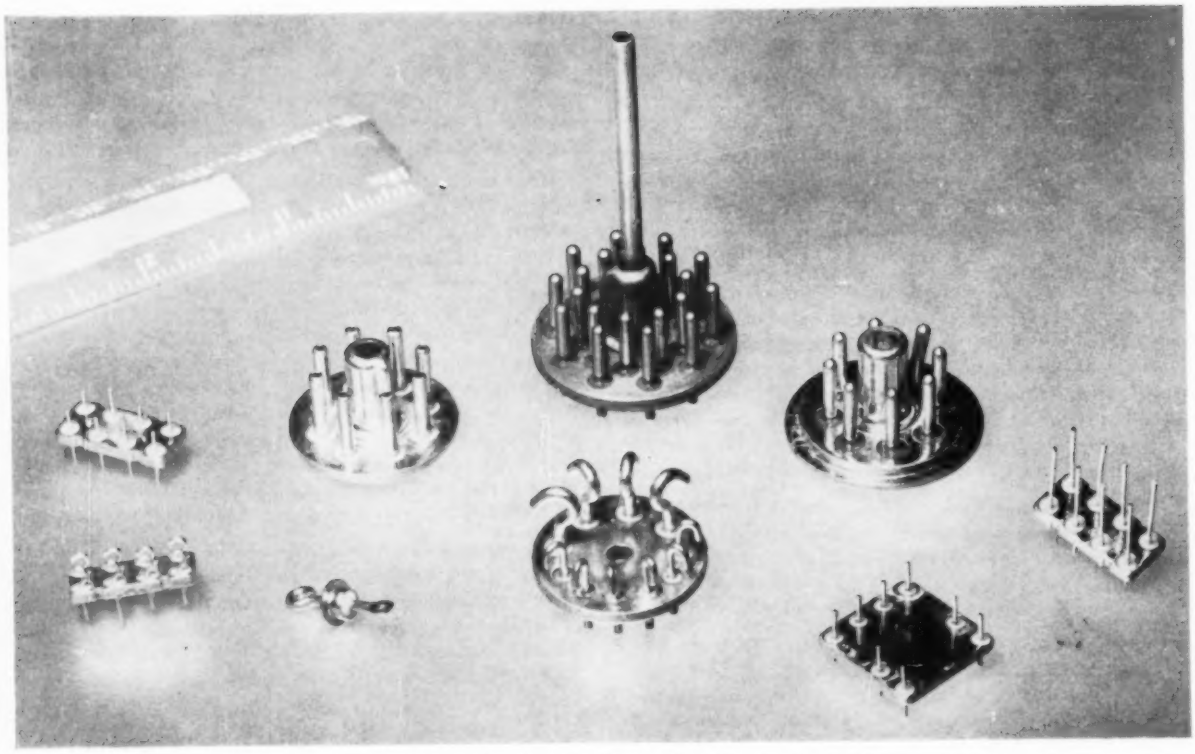
There is also present today a new family of resins that can be flame cured; that is, cured by controlled ignition of the wet film; the burning solvents simply cure the vehicle which is dissolved in it. This method is applicable only in those cases however, where the film does not shrink excessively or pull away from the edges. Higher bakes, meaning higher temperature gradients, are required to completely cure the newer Teflon, chlorinated branched olefins, Methylon phenolics, higher molecular weight epoxies, silicones, polyurethanes, polycarbonates, etc. As a general rule, the higher the curing temperature, the higher the degree of impermeability of the film, of course, assuming no film degradation.

In many cases, the particular polymer one desires can be obtained at certain temperatures only, and not at lower temperatures, no matter how long the time of cure. An interesting example is to be found in modified epoxy coatings—especially the epoxy phenolics. The polymer desired in this case is to be obtained at temperatures in excess of 425F metal temperature and preferably 450F. For this, a simple chemical test has been devised. A mixture of alkyl aryl amines, chlorinated solvents and alkali is placed over the cured film. If softening does not occur within ten minutes, the film is considered cured completely. Some prefer stain and hot solvent resistance tests. Color of the baked film alone is not a sufficient standard to go by. This is also true of phenolics and other thermoset types of film forming resins.

These are some of the changes to be anticipated. There are times when lacquer and paint suppliers will evolve an idea in formulation and the application technique will follow. Then there are times when new application techniques become available first and a host of new formulations appear shortly thereafter to match the equipment.

Hugh Edwards joined Bradley & Vrooman, manufacturer of protective packaging materials and industrial finishes, in 1955 as a senior chemical coatings formulator. He was appointed chief packaging consultant and group leader of the company's steel container linings evaluation department in 1957 and has acted in this capacity until his recent appointment as manager of packaging research and development. In his new position, Mr. Edwards is responsible for developing protective coatings, custom formulated to package specific or "hard-to-hold" products. In addition, he continues as consultant and heads an extensive lining test program.

Mr. Edwards has wide background in industrial finishing, fluid plastics and protective-packaging materials formulation, having spent the past 20 years in these related fields. A graduate of Polytechnic Institute of Brooklyn, he holds a BS degree in chemical engineering and also has done graduate work in this area at the University of Pennsylvania. Before joining Bradley & Vrooman, he was a lacquer chemist specializing in government specifications and industrial formulations. He also has experience in aircraft and automotive finishing, resin and cement chemistry. He is a member of the Phi Lambda Upsilon Honorary Chemical Society and the Chicago Paint & Varnish Production Club.



These parts were flow-brightened at 378F. Note the dull finish.

FLOW-BRIGHTENING OF TIN AND ITS ALLOYS

by SHERWOOD G. CASSELL*

IN THE ELECTRONICS INDUSTRY flow-brightening is also known as fusing or flashing and is not to be confused with hot tin dipping or hot solder dipping. Flow-brightening is an operation in which tin and tin alloys are electrodeposited and then submerged into a hot oil at a temperature tin or solder melts, whereas, hot tin dipping consists of dipping unplated parts into a molten metal bath.

* Plating Supervisor, Vacuum Ceramics, Inc., Cary, Illinois.

The two most common metals used in the electronics industry are pure tin and 60/40 solder. The solder is a utectic plate and flows at 378F, but as this temperature is increased to 410F, the solder will flow to a bright smooth finish.

OPERATING PROCEDURE

As in all plating, the surface must first be free of all foreign matter. This is particularly important when flow-brightening

tin and its alloys. If the surface is not scrupulously clean it will dewet when flow-brightened and thus cause a reject.

Experience has shown that it is not possible to successfully plate more than 0.00025 to 0.0003 in. of either tin or solder. If this limit is exceeded, the parts tend to dewet or build up in globs over the entire surface. The proper thickness necessary to attain a smooth bright finish is 0.0002 in. This thickness will give a high quality finish that far exceeds hot tin dipping.

All parts are rinsed in tap water and subsequently in hot demineralized water. The demineralized water will remove impurities such as calcium and iron. Minerals can cause a great deal of difficulty if allowed to remain on the surface and can also cause a white film to appear on the work when it is flow-brightened.

After they are well rinsed, the parts should be either centrifugally dryed or hot compressed air dryed to remove the excess water. The work is then ready to be flow-brightened. Parts should be separated to prevent touching one another as this may leave nodules when cooled or they may fuse together.

The types of fluids used are refined oils, vegetable shortenings, and animal tallows with a wax base. An animal tallow with a wax base is far better than oil or shortening. With the use of animal tallows the fusing operation takes only a few seconds; not less than 15 seconds nor more than 45 seconds. The length of time, of course, will depend upon the area of the work and the amount of heat it will take to bring the work to a flowing temperature. The work flow will be faster if it is quenched immediately after flow brightening although this is optional.

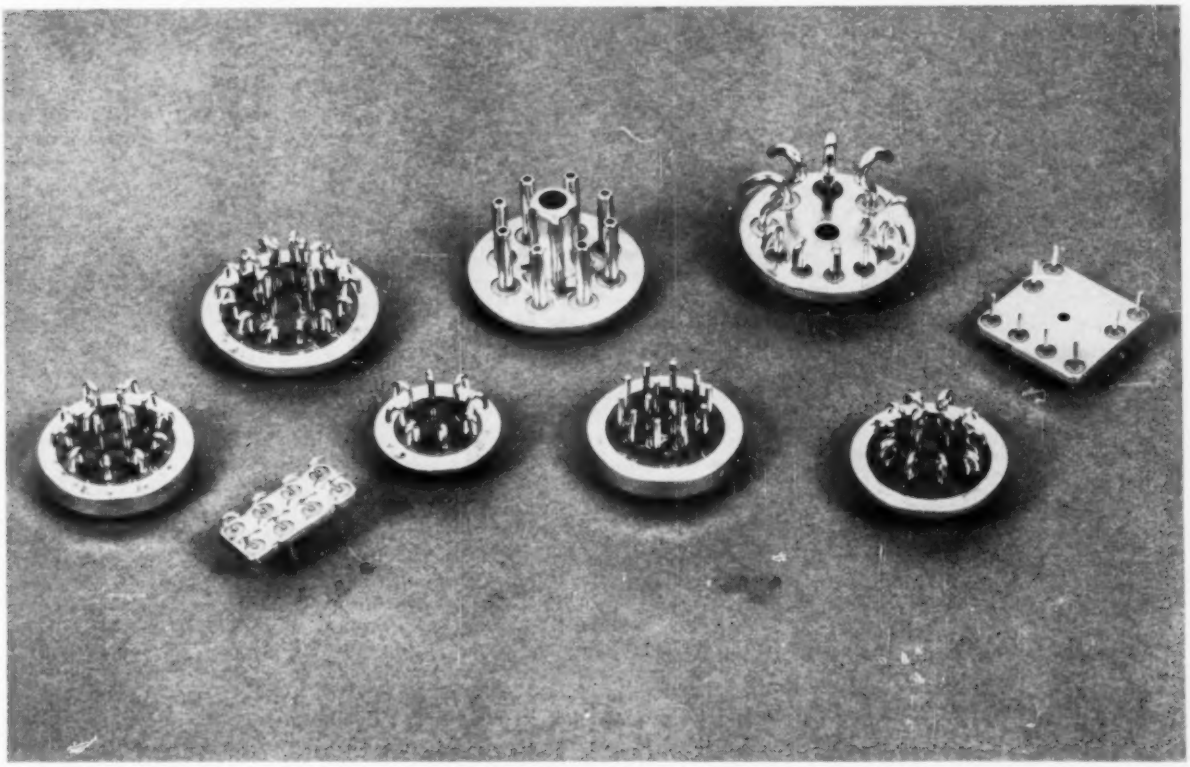
After the work has cooled enough to handle it should be vapor degreased, preferably in a perchlorethylene degreaser.

The flowing of tin has the same sequence as solder with the exception that it must be flowed at 445F to 465F, depending on the type of bath used.

If the work is allowed to sit from one to five days after plating and before flow-brightening, it will oxidize. This oxide can be easily removed by dipping the work in either fluoboric or hydrochloric acid at full strength, then rinsed in plain tap water, followed by a hot demineralized water rinse, followed by the drying process.

Work has been stored for as long as eighteen months in the unflowed condition, then flowed with no signs of discoloration or loss of quality.

Sherwood O. Cassell is plating supervisor at Vacuum Ceramics, Incorporated, in Cary, Illinois, where he is engaged in research and development of flow-brightening of tin alloys. He is a member of the Chicago Branch of the American Electroplaters' Society.



Parts flow-brightened at 410F had the bright finish shown above.

PERSONALS

JOEL R. FIELD JR. formerly of Enthone, Inc. and more recently with Chas. Dickgiesser Co., Derby, Conn. is now associated with Mitchell-Bate Co., rack manufacturers, Waterbury, Conn.

Mr. Field brings many years of broad experience in plating rack design to his new post. He will concentrate on the development of new rack designs with Mitchell-Bate Co.

J. R. Field Jr.

Walter L. Pinner

WALTER L. PINNER, a Past National President of the American Electroplaters' Society, and Honorary Member of AES and of the Institute of Metal Finishing of England, is no longer associated with McGean Chemical Company. Prior to his three years employment by McGean, Mr. Pinner had served Houdaille Industries and its predecessor companies for 35 years. In that connection, he was responsible for the technical direction of research and manufacturing procedures in one of the largest nickel and chromium plating operations in the country.

During November of this year, Mr. Pinner visited England on behalf of the Pyrene Company of London for whom he has acted as a consultant for 15 years.

After a vacation trip, Mr. Pinner plans to establish residence in the Southwest where he will be available for consulting work.

During his long and successful business career, Mr. Pinner has interested himself to a considerable degree in basis metal preparation, copper, nickel and chromium plating and corrosion. Many of his publications on these subjects have resulted in numerous awards and honors to him.

Mr. Pinner was instrumental in setting up AES Project 15 and has served as Chairman of the Project Committee since its inception. The work of that group has produced the CASS and Corrodkote tests which are in widespread use in the plating industry.

GEORGE A. STUTZ, chairman and chief executive officer of The Stutz Co., Chicago, is embarking on a new career at the age of 72—semi-retirement in Florida.

Much of The Stutz Company's growth for the past four decades is directly traceable to the influence of Mr. Stutz. The company was founded 40 years ago, in a 25 by 40 foot building. Today, Stutz is housed in a modern, 40,000 square foot plant that permits expansion to double its present output.

Though the elder Mr. Stutz is changing his status, his two sons continue in their present positions with the organization—**GEORGE L. STUTZ** as president and **RICHARD G. STUTZ** in an executive sales capacity.

In choosing semi-retirement to total retirement, Mr. Stutz explained that it is difficult to walk completely away from the company where he spent 40 years of his life. Thus, his present status permits him to participate in management level decisions and in the over-all affairs of the company.

G. A. Stutz

R. B. Stevens

ROBERT B. STEVENS has been named manager of the Midwestern Division of Maas & Waldstein Co. of Newark, N. J.

Mr. Stevens, who joined the company in 1946, will headquarter at the Chicago plant of Maas & Waldstein Co., and in his capacity as manager will be responsible for sales and service in the 19-state area which comprises the Midwestern Division.

♦

W. M. CAMPBELL has been elected chairman of the board and **E. H. PETERSON** elected president of the Magnus Chemical Co., Inc., Garwood, N. J.

Mr. Campbell, who founded the company in 1921 to manufacture and market industrial cleaning compounds, has served as its president and chairman of the board since the company's inception forty years ago. During this period, he has directed the growth of the company to its present prominence in the industry.

During Mr. Campbell's tenure as president, the company has expanded into an international organization with manufacturing and sales activities in 15 foreign countries and export sales to 20 additional countries.

Mr. Peterson, as president, becomes the company's chief executive officer. Associated with Magnus since 1947, Mr. Peterson has held the position of assistant to the president and general sales manager. Since 1960 he has had the title of executive vice president.

♦

PETER J. FREKENHORST is the newly appointed manager of The Norit Sales Company of Canada in Thornhill, Ontario. The Former manager, **B. VRIEZEN,** has been transferred to the head office in Amsterdam, the Netherlands.

♦

ROBERT D. DONALDSON has been appointed research chemist in Metal & Thermit Corporation's process development department, Rahway, N. J.

Before joining M&T, Mr. Donaldson was associated as a chemist with Hercules Powder Company, American Cyanamid Company and Allied Chemical Company. He also worked with General Aniline & Film Corporation as a market development engineer.

Mr. Donaldson received a BS degree in chemistry from Indiana University in 1942, and has done graduate work at the University of Delaware. He has been a member of the American Chemical Society since 1945.

♦

RICHARD F. LATT and **DONALD F. MOULTON** have been appointed members of Oakite Products' field service organization.

(Continued on page 1343)

GORDON J. PERKINS

The recent sudden death of Gordon J. Perkins has deprived the AES of a dedicated member and its Melbourne Branch of a devoted Secretary.

Mr. Gordon had been Branch Secretary since February 1960. He joined the Melbourne Branch in 1953. At the time of his death, he was manager of Lawrence Smith and Canning Pty. Ltd., Fitzroy, Victoria, electroplating suppliers. He had previously been with A. G. Healing Ltd., North Melbourne.

AES and PLATING MAGAZINE extend condolences to the family of the deceased and to the Melbourne Branch.

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By
WILLIAM TUCKER
Eastman Kodak
Rochester, N. Y.

Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

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Corrosion
National Association of Corrosion Engineers
1061 M & M Bldg.
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Electroplating and Metal Finishing
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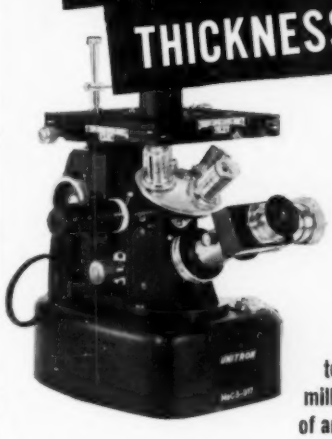

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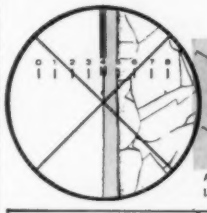

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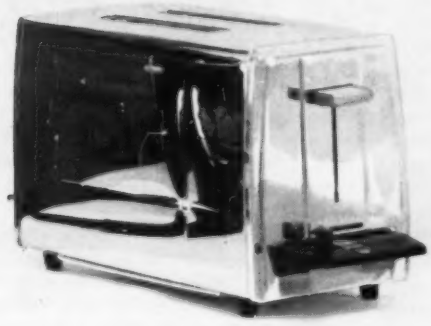
Son Chief Electrics, Inc.,
Winstead, Connecticut



HIGHER QUALITY FINISH.
On square toaster shell, same finishing operations are required with Superlume, but appearance of product is tremendously improved. On all 5 products, in fact, Superlume has stepped up product quality appreciably—and, in every instance, *at no increase in cost.*

Son Chief Electrics, Inc., appliance makers, sought a thicker, brighter plate, more rapidly applied. They found it in Superlume—along with major reductions in finishing operations, plus what Nick Lazzaro calls "Tremendous improvement in our products' appearance . . . a real breakthrough in quality."

Actually, Son Chief is plating *twice* as thick in the same time as before (using 60 amps per sq. ft. instead of 30).

They're plating flat pieces now and forming *after* plating . . . a big production advantage unique with highly ductile Superlume.

Superlume bath is easier to maintain. Son Chief's normal operating schedule is 5 days, 16 hours a day. But for two months every year, they work on a *24-hour/5-day basis.* Average pieces per hour through trouble-free Superlume: 336, with a low of 226, a high of 904. Son Chief plates 30 different parts ranging from 1 to 20 inches long. Superlume bath in use: 3100 gallons.

Good-sized operation . . . healthy benefits . . . no added production costs. For full facts on Superlume as applied to *your* operation, contact H-VW-M. Chances are you, too, will be better off with this better bright nickel bath.

H-VW-M
Progress in metalfinishing through advanced processes • equipment

Hanson-Van Winkle-Munning Company, Matawan, New Jersey
Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco

MIDWEST COUNCIL'S SYMPOSIUM ON PLATING EXOTIC METALS SCORES TRIUMPH

by Alexander Alexander

The Third Annual Technical Seminar sponsored by the Midwest Regional Council of American Electroplaters' Society, Inc. (AES) held at Argonne National Laboratories on Saturday, October 28 not only drew 241 AES members and guests but was adjudged one of the most educationally significant scientific sessions sponsored by the Society. It featured eight important papers on the plating of the various exotic metals now coming into common production through the needs of the "Space Age."

THE SEMINAR'S UNIQUE LOCALE

A more fitting site could not have been chosen by the General Co-Chairmen, namely Dr. Jay H. Monaweck and Clyde Kelly, than this great institution of scientific research whose many projects include such items as the development of metal finishing processes and techniques as related to nuclear energy. All who so desired were escorted on short, guided field trips through three of the buildings of this AEC research institution which is operated under contract by the University of Chicago. Everyone who toured this great project was impressed by the complex scientific experiments in progress, and some of those which are still in the planning and building stage.

THREE GROUPS ABSORB KNOWLEDGE

A short talk welcoming AES to the laboratory and outlining its aims and achievements was given by one of its officials to open the assembly. Immediately following this welcoming talk, the group broke up, some taking the first field trip, others heading for the morning workshops. A third AES group remained in the large auditorium where the first paper of the Symposium was "Plating On Uranium" by Dr. Jay H. Monaweck of Argonne Laboratories. The Symposium continued with a paper by Dr. George Dubpernell of the Metal and Thermit Corp., on "Electroplating Chromium And Its Alloys." Christopher Marzano of Amphenol Borg Electronics company followed with "Plating On Tungsten." The final paper of the morning was given by Dr. D. Gardner Foulke of the Sel-Rex Corporation who spoke on "Plating On Precious Metals."

While these papers were being given, Thomas McCullough of National Lock Co., moderated the "Organic Finishing Workshop." Its panel included J. M. Andrus (Croname Inc.); Peter Iwema (Du Pont Finishes Division); James F. Wright (Wright Metal Processors) and Frank Foreman (Barber Coleman Co.).

Simultaneously, in still another conference hall, S. P. Gary of Scientific Control Laboratories moderated an interesting and well-attended workshop on "Pickling and Bright Dipping" whose excellent panel of experts included Jack Eley (E. I. Du Pont de Nemours); William P. Innes (McDermid Inc.); John Jumer (Alchemize Corp.); Kenneth Westerberg (Mechanical Plating Co.) and Robert Schub (London Chemical Inc.).

Both of these workshops, as well as those in the afternoon, were packed to capacity.

AFTERNOON SESSIONS MAINTAIN MORNING'S PACE

Following a succulent steak luncheon in the Laboratory Cafeteria, the meetings reconvened at 1:45. In the main auditorium, Christopher Marzano presented a second paper, namely "Deposition of Uranium From Molten Salts," featuring results of his research while associated with the Argonne National Laboratories. Workshops on "Barrel Plating" and "Cleaning" convened in smaller chambers elsewhere.

The Symposium continued with a paper "Plating On Titanium" by W. B. Harding of the Bendix Corporation, who was then followed by the representative from another atomic laboratory at Los Alamos. James Gore then presented a paper on "Plating On Uranium" offering some practical procedures for electrodeposition on the various forms of this metal. The session concluded with an interesting paper, "Plating Various Metals On Silicons" by Dr. George Wertwejn.

The Symposium was given unanimous acclaim by all who attended.

So as to enrich the literature of the industry, Educational Chairman R. Scott Modjeska announced that all papers given at the Symposium, together with a selected group of related papers given under different circumstances in this related area of investigation, will be offered for AES publishing consideration to the AES Publications Committee.

Meanwhile the workshop on "Barrel Plating," ably moderated by E. P. McCoy, Electrochemical Products Co. gave the panel consisting of Joseph Corre (Amphenol-Borg Electronics Co.); Dr. Russel E. Harr (Western Electric Co.); William Geissman (National Lock Co.) and Herman A. Tessmann (Allen Bradley Co.), a truly active session.

In Room 183, a "Standing Room Only" crowd gave the workshop on "Cleaning" a wealth of intelligence on difficult cleaning problems. The "Cleaning" panel was moderated capably by Dr. Edward B. Saubestre of Enthone who kept things moving for Robert Lewis (Northwest Chemical Co.); Robert Bender (Oakite); Robert Goodsell (Enthone); Edward Stack (MacDermid) and Clarence Kolzow (Western Electric Co.).

MIDWEST COUNCIL IN EXECUTIVE SESSION

At 4:45 p.m. Leslie L. Diveley, Chairman of the AES Midwest Regional Council called the Council to order and introduced National President Chester G. Borlet, who, after commenting upon the significance of the day's Seminar as a true expression of the purpose of the Society in a free inter-exchange of technical data, then discussed the importance of the current Supreme Society referendum as to TECHNICAL PROCEEDINGS.

Washington University, St. Louis, Missouri, was then selected by the Midwest Council as site of its Fourth Annual Technical Seminar. It will occur late in October 1962. This meeting will be under the general chairmanship of Anthony P. Julius of the St. Louis Branch.

(Left) Part of the overflow crowd at the Barrel Plating Workshop of the Midwest Regional Council's Third Annual Technical Seminar. L to r, Joe Corre, Dr. Russel E. Harr, Moderator E. P. McCoy, Herman Tessmann and William Geissman. (Center) In welcoming address, Mr. Krisciunas of Argonne National Laboratories provided the AES members with brief history and explanation of the purpose and operation of the laboratories. (Right) Big attendance—note the standees—at the afternoon workshop on Cleaning.

AES NEWS

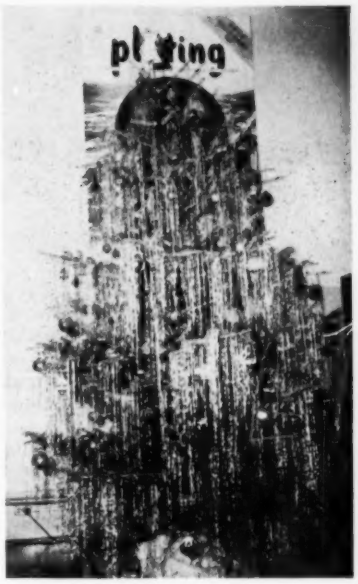
ABUNDANT EDUCATIONAL FARE IN AES MEETINGS AHEAD

The AES will cross into the most congested portion of its 1961-1962 educational season with the arrival of the new year. It will gain 1962 momentum with two large Branch Annual Educational Meetings in January, besides the Ninth Interim Meeting of the Supreme Society that will occur during that same month.

First, the Grand Rapids Branch will conduct its Annual Meeting at the Pantlind Hotel on Saturday, January 20. Then, as an element of its own Fiftieth Anniversary, the Chicago Branch will stage its Annual Educational Meeting and Banquet at the Conrad Hilton Hotel, Chicago, January 27.

With the Southeastern Branch, "mother" Branch of the AES Dixie Region as host, the fourth Annual Dixie Regional Educational Meeting will be conducted at the Dinkler-Plaza Hotel, Atlanta, Georgia, on February 9-10. A week later, the New York Branch will produce its Annual Technical Session and Banquet at the Statler Hilton Hotel in New York on February 17.

The many other major Regional and Branch Meetings ahead are listed in the section carried elsewhere in this issue of PLATING MAGAZINE entitled "Future Meetings." As information concerning additional AES assemblies reach PLATING, they will be carried in subsequent monthly issues. The season will of course reach its apex with the fiscal year's climax AES educational event, namely the 49th Annual Convention, Schroeder Hotel, Milwaukee, June 24–28, 1962.



BOOKS OF KNOWLEDGE
Education is the business of AES. For technical literature to expand technical knowledge, see AES BOOK SECTION, Pages 1349-1355.

SANTA CLARA BRANCH CHARTERED AS AES'S 62nd BRANCH

The 62nd Branch of American Electroplaters' Society, Inc. (AES) came within the company of AES's chartered Branches with the permanent chartering of the Santa Clara (California) Branch by the Executive Board recently, effective October 15, 1961. Thus the AES vision of "62 Branches in '62" has been fulfilled—with further growth looming ahead.

An offshoot of the San Francisco Branch created so as more effectively and conveniently to accommodate burgeoning electroplating and metal finishing in that area of the United States' fast-developing Pacific Coast, the Santa Clara Branch, already nearly 50 Active Members strong, will officially be installed as a full-fledged Branch of the Society by an installation team of AES National Officers at an appropriate Branch meeting soon to be scheduled. Watch for further, fuller details in an early PLATING MAGAZINE issue.

CENTRAL IOWA BRANCH INSTALLED AS THE SOCIETY'S 61st BRANCH

Expectedly a sizable AES Branch in the making, AES's Central Iowa Branch was officially installed as the Society's 61st permanently chartered Branch at an impressive Installation Meeting held November 16, 1961 at the Roosevelt Hotel, Cedar Rapids, Iowa.

National President Chester G. Borlet himself 1) installed the Branch and its first complement of permanent Branch Officers, 2) presented it with its laminated charter and 3) indoctrinated its first elected delegation to represent it on the Supreme Society, AES's governing council.

The fuller story of the event will be reported in PLATING MAGAZINE's next issue.

AES LAPEL BUTTONS

The AES member's handsome sterling silver lapel button can be purchased from your Branch Secretary at $1.38 per button including tax. These, in turn, can be purchased by Branch Secretaries from National Headquarters at that amount. The sterling silver Branch Past President's button can be purchased by Branch Secretaries from the National Office at $1.43 per button including tax.

FOUR NOMINEES VYING FOR HIGHEST AES SCIENTIFIC AWARD

Four distinguished AES members were nominated by five AES chartered Branches, by the Award's October 15, 1961 deadline, for consideration for the 1961-1962 AES Scientific Achievement Award, the Society's highest scientific honor.

The four candidates were respectively nominated by the Baltimore-Washington, Bridgeport, New Haven and Pittsburgh Branches of the Society. One Branch nominated first and second choices. Two Branches nominated the same scientist.

The nominating forms and dossiers of each nominee have now been channeled to the AES Scientific Achievement Award Selection Committee. Its selection will be made by April 1 and will be announced at the Grand Opening Session of the Society's 49th Annual Convention, Schroeder Hotel, Milwaukee, Wisconsin, June 25, 1962.

The 1961-1962 award winner will deliver the annual "William Blum Lecture" at the AES Atlantic City Convention in June 1963, and will then receive a $500 honorarium, a handsome laminated scroll and attendant honors.

In Memoriam

PAST NATIONAL PRESIDENT EDWARD J. MUSICK

The Society was saddened by the death on October 30, 1961 of one of its most respected leaders, namely Past National President Edward J. Musick (St. Louis Branch) of 38 Willow Hill Road, Ladue, St. Louis County, Missouri. He succumbed to arteriosclerosis at the Deaconess Hospital, St. Louis, at the age of 78.

Mr. Musick was President of Musick Plating, Inc., a company created 82 years ago by his father, the late William Musick —a concern said to be the first company of its type in St. Louis.

A founder of the nearly half-century old St. Louis Branch, a Branch Past President and one of its buttresses since the Branch's birth, "Ed" as he was affectionately known throughout the Society, earned election to the AES's coveted circle of National Honorary Members in 1949. He headed the Society as National President in 1925–1926.

A popular figure at most AES National Conventions through the years, he was present at the Los Angeles Convention in 1960. There, he amazed his many friends by taking his place on the dais of the Grand Opening Session despite a fractured rib incurred in an accident earlier that very same forenoon. Besides his AES membership, Mr. Musick was a member of the Rotary Club, the American Society of Tool Engineers and was a Past President of St. Louis's Manual Training School from which he was graduated in 1902.

The decedent is survived by his daughter, Mrs. Ruth M. O'Donnell, with whom he made his home, two granddaughters, two sisters, a brother and seven great-grandchildren. To his family and to the St. Louis Branch, AES and PLATING MAGAZINE extend deep sympathy over their great loss.

FUTURE MEETINGS

Education is the business of AES. For National, Regional and Branch educational and other AES meetings ahead, see PLATING's section titled FUTURE MEETINGS herein.

BOSTON CONVENTION TECHNICAL PAPER REPRINTS AVAILABLE

Copies of the 1961 Edition of TECHNICAL PROCEEDINGS have now been mailed to all members in good standing of AES (as at November 1, 1961) as an entitlement of AES membership. A limited quantity of excess copies of the book are now available for purchase by non-members and others on a "first-come-first served" basis, so long as that excess supply lasts, at a per-copy price of $18 domestic, $22 foreign, including postage—full payment with order required (See descriptive item, Page 1351).

The 1961 Edition embodies the full text and illustrations of every technical paper presented by experts at the Society's 48th Annual Convention, Boston, Massachusetts, June 18–22, 1961, together with the transcript of the discussion that attended the delivery of each such paper

For those companies or individuals desiring to purchase a quantity of reprints of any of the copyrighted papers appearing in that AES book (other than the four Aluminum Finishing papers delivered before the "Finishing of Light Metals" Symposium of that AES National Convention), there is a price list available upon request, specifying cost and how to order. Address your request for information to Thomas W. Lowe, Production Manager, TECHNICAL PROCEEDINGS, American Electroplaters' Society, Inc., American Building, 443–445 Broad Street, Newark 2, N. J.

FOUR BRANCH FIFTIETH ANNIVERSARIES TO BE OBSERVED IN 1962

With the turn of the New Year, three AES Branches will be observing their GOLDEN ANNIVERSARIES as such, namely Detroit, Chicago and Toronto. A fourth, the Indianapolis Branch, was also born in 1912 but was a 1933 victim of the Great Depression. It was reactivated in 1940 and has, ever since, been one of the Society's sturdiest and effective Branches.

Tenth Anniversaries will be observed in 1962, a) by the Society's upsurging Kansas City Branch and, b) by its Wichita Branch.

PROGRAM OF EVENTS

NINTH INTERIM MEETING SUPREME SOCIETY AMERICAN ELECTROPLATERS' SOCIETY, INC.

MAROTT HOTEL, INDIANAPOLIS, INDIANA
JANUARY 11-14, 1962

	ROOMS
THURSDAY, JANUARY 11	
9:00 a.m.—Editorial Board	Parlor E
8:00 p.m.—Executive Board	Parlor D
FRIDAY, JANUARY 12	
9:00 a.m.—Executive Board Meeting (Noon Recess)	Parlor D
9:30 a.m.—AES Constitution and Bylaw Revision Committee Meeting (All Day)	Parlor E
2:00 p.m.—AES Membership Committee Meeting	Parlor D
2:00 p.m.—AES Educational Committee Meeting	Parlor C
6:30 p.m.—Dutch Treat Cocktail Party and Dinner of AES Delegates and Branch Members. Sponsored by the Indianapolis Branch. Delegates and other Branch Representatives welcome. Dinner tickets (only) $3.75 per person. Speaker: Dr. Abraham M. Max on "The Education of a Plater." Reservations must be received not later than January 10, 1962. Mail to Quentin O. Shockley, 3211 Medford Avenue, Indianapolis 22, Indiana (not to National Headquarters)	MacMillan Room
SATURDAY, JANUARY 13	
9:00 a.m.—Interim Meeting Registration	Foyer, Industry Room
10:00 a.m.—Ninth Interim Meeting, Supreme Society	Industry Room
1:00 p.m.—Luncheon (Dutch Treat)	
2:00 p.m.—Ninth Interim Meeting, Supreme Society	Industry Room
8:00 p.m.—Joint Meeting, National Officers and AES Constitution and Bylaw Revision Committee	Parlor E
SUNDAY, JANUARY 14	
9:00 a.m.—Executive Board Meeting (To Adjournment)	Parlor E

HOST
INDIANAPOLIS BRANCH

INTERIM MEETING REPORTER

MAROTT HOTEL
INDIANAPOLIS, INDIANA
JANUARY 11-14 1962

LARGE REPRESENTATION EXPECTED AT GOVERNING COUNCIL'S NINTH INTERIM MEETING

With AES's Indianapolis Branch as host and Quentin O. Shockley of that Branch as General Arrangements Chairman, the Ninth Interim Meeting of this Society will be held at the Marott Hotel, Indianapolis, Indiana, Saturday, January 13, 1962. AES Board and Committee Meetings will occur on two prior days at the same hotel.

The Editorial Board will convene for a full day's important meeting on Thursday, January 11. The Executive Board will conduct its regular meeting that same evening and the following forenoon—then reconvene on Sunday, January 14 to complete its business.

The "AES Constitution and Bylaw Revision Committee" will assemble in executive session during the entire day on Friday, January 12. That same afternoon, the AES Membership Committee and the AES Educational Committee will respectively hold full afternoon sessions.

Assembled Delegates, Alternate Delegates and Branch Representatives will have an opportunity to dine together (Dutch treat) Friday evening at the dinner meeting of the Indianapolis Branch to which all AES members will be welcome to attend. Dinner tickets are priced at $3.75 each. The event will occur in the MacMillan Room. Speaker will be Dr. Abraham M. Max who will discuss "The Education of a Plater." Reservations must be received by Mr. Shockley (3211 Medford Avenue, Indianapolis 22, Indiana) by not later than January 10.

Saturday's Supreme Society Meeting will commence at 10:00 a.m. and will face the agenda that is spread elsewhere on this page. The meeting will recess for a Dutch treat luncheon of Delegates and Alternates at 1:00 p.m. and will resume an hour hence. Adjournment by 5:00 p.m. is expected.

Whereas the adjournment of the Supreme Society Meeting will terminate all planned activities of Delegates, Alternates and Branch Representatives, the Executive Board will, nevertheless, meet in joint session with the "AES Constitution and Bylaw Revision Committee" that Saturday evening.

Marott Hotel, Indianapolis, where the Supreme Society will hold its Ninth Annual Meeting, January 13, 1962. It also housed Fifth Interim Meeting (1958).

TENTATIVE AGENDA NINTH INTERIM MEETING AES SUPREME SOCIETY

MAROTT HOTEL
INDIANAPOLIS, INDIANA
JANUARY 13, 1962

1. Welcome by Indianapolis Branch.
2. Welcome by National President.
3. Opening of the Session as an Interim Meeting. Purpose of the meeting as a sounding board on matters for subsequent consideration and action by the Supreme Society at its Annual Meeting in Milwaukee, June 28, 1962.
4. Progress and Status Reports:
   Financial by President.
   Educational by First Vice President.
   Membership by Second Vice President.
   Branch Regionalization, Regional Annual Meetings and Branch Monthly Meetings as tools of AES Educational Mission by Third Vice President.
   Honorary, Merit and Achievement Awards as inducements for Greater AES Service by Immediate Past President.
   Headquarters and AES Publishing and Public Relations by National Executive Secretary.
   AES Research Program by Chairman, Research Committee.
5. Preliminary Reports:
   a) Executive Board Appraisal as to AES Financial Structure, including outcome of Referendum as to TECHNICAL PROCEEDINGS and its effect.
   b) Report of the AES Constitution and Bylaws Revision Committee.
6. AES National Conventions and Interim Meetings
   a) 1962 Milwaukee Convention (Milwaukee Convention General Chairman).
   b) Other AES National Conventions Ahead.
   c) Report of Outcome of Boston 1961 Convention.
   d) Progress Report on St. Louis Industrial Finishing Exposition (1964).
7. Invitations from Branches to Host 1968 National Convention or 1964 Interim Meeting.
8. New Business Brought for Discussion by Delegates.
9. Announcement of Candidates for Third Vice Presidency.
10. Adjournment.

FORTY-NINTH ANNUAL CONVENTION
AMERICAN ELECTROPLATERS' SOCIETY, INC.

SPONSOR:	American Electroplaters' Society, Inc. (AES), American Building, 443-445 Broad Street, Newark 2, New Jersey, and its 61 chartered American, Canadian and Australian Branches.
HOST:	The Midwest Regional Council of AES, including its Chicago, Milwaukee, Mississippi Valley, Rockford, St. Joseph Valley and St. Louis Branches.
SITE AND HOTEL:	Schroeder Hotel, Milwaukee, Wisconsin.
DATES:	June 24-28, 1962, in AES's fifty-third year.
ADULT REGISTRATION:	For male and female adults—$25 per person including Banquet, Outing, and all other AES official Convention events.
CHILDREN REGISTRATION:	For registered children—$15 per child, not including Banquet, but including three days of supervised sightseeing and children's program events, plus the Outing.
HOTEL ACCOMMODATIONS:	Order direct via Hotel Reservation Form to come to AES members in January 1962 from the Convention Committee via AES National Headquarters.
CONVENTION GENERAL CHAIRMAN:	Herman A. Tessmann (Milwaukee Branch), 3864 South 57th Street, Milwaukee, Wisconsin.
LADIES CHAIRMAN:	Mrs. Charles Auchter, 920 East Wye Lane, Milwaukee 17, Wisconsin.

GRAND OPENING SESSION • EDUCATIONAL PROGRAM • AES BOARD AND COMMITTEE MEETINGS • LADIES PROGRAM • CHILDREN'S PROGRAM • PLANT TOURS • DANCES • SIGHTSEEING • OUTINGS • UNIQUE CONCERT • SPONSORED RELAXATIONAL PROGRAMS • COCKTAIL PARTIES • GET-TOGETHER • GOLF TOURNAMENT • BANQUET • ENTERTAINMENT • FLOOR SHOW • ANNUAL BLUM LECTURE

Joseph M. Andrus
Convention Educational Chairman

KNOWLEDGE AND YOU!

Imparting technical knowledge on electroplating, metal finishing and allied arts is the prime function of any AES National Convention—and that policy and practice will mark the Society's 49th Annual Convention, June 24-28, 1961 at the Schroeder Hotel, Milwaukee, Wisconsin, with the AES's Midwest Regional Council as Host.

Being programmed by the Host Region's Educational Session Committee headed by Joseph M. Andrus (Chicago Branch), under the planning and supervision of the Society's Editorial Board, is one of the most versatile Educational Session programs in AES's long convention history.

Besides the Fourth Annual William Blum Lecture, the tentative program envisions 1) a Research Session, 2) a "Color" Session, 3) a "Specifications" Session, 4) general sessions on other phases of plating, finishing and allied arts and 5) a possible "round table" on "Cost Saving Ideas in the Plating Room." Watch PLATING MAGAZINE's future issues for further information as it develops.

PLAN NOW TO ATTEND
AES'S MILWAUKEE CONVENTION,
JUNE 24-28, 1962

Hotel Schroeder, 1962 AES Convention Headquarters

INTERSOCIETY NEWS

GAY IS NEW MANAGING DIRECTOR OF ASA

Roger E. Gay, former president of the Bristol Brass Corporation, will succeed Vice Admiral George F. Hussey, Jr., USN (Ret), as managing director of the American Standards Association effective January 1962.

Mr. Gay is leaving his management consultant practice to become the third managing director of the 43-year-old voluntary national standards body. President of ASA from 1952–1954 and a member of its board of directors for nine years, he joined the ASA staff November 1. He is a fellow of the Standards Engineers Society and received in 1957 the annual award of SES and the American Society for Testing and Materials.

ASTM SECRETARY URGES PAN-AMERICAN STANDARDS

The importance of developing industrial standards for Latin American nations to the progress of the Western Hemisphere was stressed by T. A. Marshall Jr., executive secretary of the American Society for Testing and Materials, in a speech before the American Standards Association, Inc., during their 12th National Conference on Standards, October 10–12, in Houston, Texas.

Mr. Marshall described the efforts of the Pan American Standards Committee (CNPT) to prepare new technical standards and to modify the standards of various countries to meet the needs of Latin America.

"How successfully we improve relations with our neighbors to the south and assist them in their economic development and industrial growth," Mr. Marshall said, "will depend to a major extent on how well we in America do our share."

"There are three ways in which we can help:

(1) We must actively support and participate in the standards activities of our major American standardizing bodies which cooperate with the Pan American Standards Committee . . .

(2) We must actively participate in and support the standardizing bodies in Latin American countries.

(3) We must develop acceptable translations into Spanish and Portugese of selected American and ASTM standards as a base for agreement on Pan American Standards."

♦

ELECTROFORMING SYMPOSIUM PROGRAM ANNOUNCED BY COMMITTEE B-8

ASTM Committee B-8 proudly announces an event of unusual interest which will occur at the Statler-Hilton Hotel in Dallas, Texas, on February 6 and 7, 1962. Coinciding with ASTM Committee Week, there will be a two-day symposium enentitled "Electroforming—Its Applications, Uses and Properties of Electroformed Metals."

Electroforming, the science of creating or reproducing objects by electrodeposition, is a growing industry. While several technical articles have been written on the subject, this will be the first time that a comprehensive coverage of the industry will be made by recognized authorities in the electroforming field. The two-day session will include papers and discussions on the solutions used, the techniques employed and the applications of the science to the creation or reproduction of objects in the various fields as listed in the program.

A. D. Squitero and W. L. Pinner, co-chairmen of the symposium, announce the program as follows.

SYMPOSIUM ON ELECTROFORMING ITS APPLICATIONS, USES AND PROPERTIES OF ELECTROFORMED METALS

Statler-Hilton Hotel
Dallas, Texas
February 6 and 7, 1962

9:00 a.m. Tuesday, February 6
SESSION A—INTRODUCTION, SOLUTIONS AND DEPOSIT PROPERTIES
Chairman E. B. Saubestre

1. Introduction to Electroforming
   —A. Kenneth Graham
   Graham, Savage and Associates, Inc., Jenkintown, Pennsylvania
2. Modern Electroforming Solutions and Their Applications
   —Myron B. Diggin
   Hanson-Van Winkle-Munning Company, Matawan, New Jersey
3. Physical and Mechanical Properties of Electroformed Nickel at Elevated Temperatures
   —C. H. Sample and B. B. Knapp
   International Nickel Company, Inc., New York, New York
4. Physical and Mechanical Properties of Electroformed Copper
   —William H. Safranek
   Battelle Memorial Institute, Columbus, Ohio

2:00 p.m. Tuesday, February 6
SESSION B—ENGINEERING, AUTOMOTIVE, SOUND AND MISCELLANEOUS PARTS MANUFACTURE
Chairman A. H. DuRose

1. Practical Methods in the Use of Electroforming Masters, Mandrels and Matrices
   —Frank R. Bottomley
   Gar Precision Parts, Inc., Stamford, Connecticut
2. The Application of Electroforming to the Manufacture of Disc Records
   —A. M. Max
   Radio Corporation of America, Indianapolis, Indiana
3. Electroforming Plastic Molds for the Automotive Industry
   —Phil J. Ritzenthaler
   Plating Engineering Company, Milwaukee, Wisconsin
4. Manufacture of Typing Wheel Electrotypes and Other Electroformed Piece Parts
   —Kenneth W. Franks
   Teletype Corporation, Skokie, Illinois

9:00 a.m. Wednesday, February 7
SESSION C—AVIATION AND AEROSPACE APPLICATIONS
Chairman R. B. Saltonstall

1. Electroforming Hardware for Aerospace Vehicles
   —D. L. Alfie and J. C. Ladd
   General Dynamics Corporation, Fort Worth, Texas
2. Alloy Electroforming for High Temperature Aerospace Applications
   —Myron E. Browning
   American Machine and Foundry Co.
3. Electroforming Supersonic Pitot-Static Tubes
   —Frank K. Savage
   Savage-Rowe Plating Company, Inc., Kalamazoo, Michigan
4. Electroforming of Venturi-Type Liners for Wind Tunnels and Other Applications
   —Paul C. Silverstone
   Electroforms, Inc., Gardena, California

2:00 p.m. Wednesday, February 7
SESSION D—ROUND TABLE DISCUSSION
Chairman A. D. Squitero

1. Movie—The Manufacture of Electrotype Printing Plates
2. Round Table Discussion

♦

PLANT ENGINEERING SHOW SET FOR PHILADELPHIA

A new emphasis on management techniques will feature the next Plant Engineering and Maintenance Show and Conference at Convention Hall, Philadelphia, January 22 through 25.

This shift of emphasis is made necessary by vast new areas of scientific knowledge and engineering skills which have been developed since the show and conference started in 1950.

Although many of the 43 conference sessions will still be devoted to discussions of preventive maintenance, repairs and inspections, new subjects have been added to cover management techniques, previously applied only to production methods, which may now be used in the areas of plant engineering and maintenance. Included will be such topics as cost control, operation-time control, work sampling, personnel relations, motivation of supervisors, plant communications and similar tools of management.

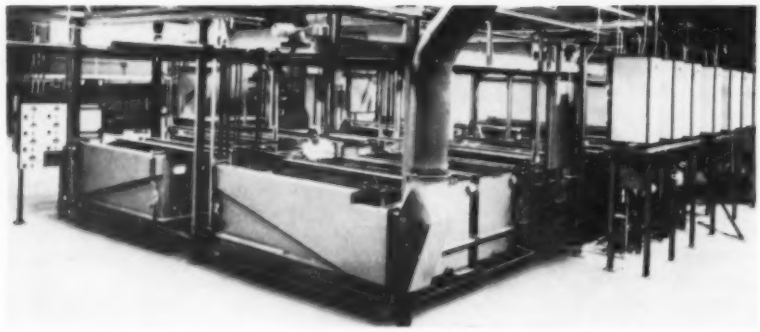
♦

CHEMICAL COMPANIES TO OBSERVE PROGRESS WEEK

Chemical companies in conjunction with their local facilities all across the U. S. will observe "Chemical Progress Week" in 1962 during the week of April 9–13, it has been announced by the Manufacturing Chemists' Association, Inc., the oldest chemical trade association in the country.

Purpose of the ninth annual observance, it was stated, is "to emphasize how chemistry, chemical research and the chemical industry beneficially contribute to the American people in their daily lives."

INDUSTRY NEWS



NEW MODERN PLATING SYSTEM AT ROYAL METAL

A specially-engineered plating system in its new Michigan City plant is providing Royal Metal Manufacturing Company with one of the world's most modern plating departments.

The core of the new system is a new $200,000 nickel-plating machine specifically designed and manufactured for Royal Metal by the Crown Rheostat and Supply Company, Chicago.

The machine is fully automatic and can operate up to a speed of about 14 cycles an hour. It has individual plating tanks, each with its own source of power and control. This, in turn, gives the machine a definite and precise quality control system. The machine itself is about 30 feet wide, 60 feet long and 20 feet high.

The nickel-chromium plating process starts with preparation of the metal by polishing and vapor degreasing to remove all foreign organic materials prior to the cleaning cycle.

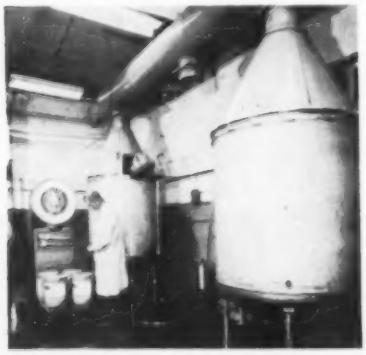
An electrochemical method then cleanses the material and it undergoes a double cold water rinse, followed by a hydrochloric acid dip and a double cold water rinse. The process is repeated with the substitution of sulfuric acid for the final acid dip.

The material is then ready to receive the nickel plate which will deposit a thickness of +0.001 in., requiring about 20 minutes. After the removal of the material from the plating solution, it is given a hot and cold water rinse and thoroughly inspected.

As a final step, crack-free chromium plate is applied after the metal has undergone the proper hand finishing operation for bright or satin chromium.

ENTHONE INCREASES FACILITY FOR PLATING CONCENTRATES

A new production facility for the large scale production of its recently released 'Enplate' chemical plating process has been



installed by Enthone, Inc. This installation facilitates the production of high-purity chemical plating solution concentrates, in addition to greatly increasing the output capabilities of Enthone in this field.

The highly purified 'Enplate' chemical plating products are produced with de-ionized water. The equipment is all constructed of stainless steel and plastic in order to avoid contamination of the solutions. After mixing, the finished product is filtered and transferred to the shipping container through plastic tubing. Due to the quality control employed in the production of the products, it is claimed that there are no preparatory steps required to obtain perfect electroless deposits immediately after bath make-up.

♦

ABBEY AUTOMATION EXPANDS TO NEW QUARTERS

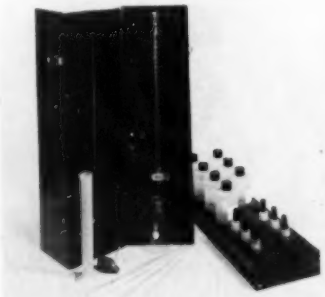
Harold G. Abbey, president of Abbey Automation Systems, Inc., has announced that manufacturing and engineering facilities have been moved to their new site at 232 Varet Street, Brooklyn.

With the acquisition of a building large enough to house engineering, design, manufacture and sales, customer requirements can be expeditiously and economically processed. The new site, complete with demonstrating equipment and conference rooms, is available for visitation. Future development, present design and demonstration of "leap-frogging" may be viewed. A full technical staff to discuss processing and design supplies and equipment for processing will be stored at the present site in Long Island City.

♦

ANALYSIS KIT INAUGURATED BY MacDERMID

For customers who lack the facilities for a fast, trouble-shooting check of their metal finishing solutions MacDermid Incorporated now provides a new service, a compact but complete "Trouble-Shooting Kit" that can be carried by every MacDermid salesman right into the plating room.



By using his new kit in the cutsomer's plant, the MacDermid representative can not only pin-point the source of trouble, but also make recommendations to solve the problem.

Since samples of the solution in question no longer have to be sent or taken to the supplier's laboratory for analysis, platers can restore their bath to trouble-free operation with a minimum of down-time.

CORRECTION

Equation 1 in the paper "Measurement and Automatic Control of the Etching Strength of Ferric Chloride" by Willard Greer published on page 1095 of the October 1961 issue of PLATING MAGAZINE was incorrect. It should have appeared as follows:

$$Cu + 2Fe^{+++} \rightarrow Cu^{++} + 2Fe^{++}$$

INDUSTRY NEWS BRIEFS

BEE CHEMICAL HAS NEW DISTRIBUTOR

Bee Chemical Company, Lansing, Illinois, has appointed Chapman Chemical Company, Memphis, Tennessee, as distributor for Bee Chemical's Lacqua products.

Chapman Chemical Company, manufacturers and distributors of industrial chemicals, will handle distribution in the states of Tennessee, Georgia, Alabama, Mississippi, Louisiana and Arkansas.

Bee Chemical is expanding sales coverage of their products through a recently established national distributorship program.

♦

NORTHWEST CHEMICAL ADDS CONVERSION CHEMICAL PRODUCTS

Northwest Chemical Company has concluded an agreement to distribute in midwestern states the chemical specialties produced by Conversion Chemical Corporation.

Northwest Chemical, a Detroit unit of the Chemical Products Division of Chemetron Corporation, is manufacturer of chemicals widely used in the metalworking industry, including cleaning and phosphatizing chemicals. Conversion Chemical of Rockville, Connecticut, produces the Kenvert line.

The new distribution channel enables metal finishers in the midwest, West Virginia and western Pennsylvania to obtain from a single source a complete line of chemicals.

♦

BOOKLET OFFERED BY BATTELLE IS GUIDE TO SCIENTIFIC EDUCATION

"Is There a Future Scientist or Engineer in Your Home?" is the title of a booklet just released by Battelle Memorial Institute, Columbus, Ohio. The booklet is offered as a primer to help parents and leaders of young people in the discovery and encouragement of the nation's future scientists and engineers.

The booklet outlines characteristics which may indicate an embryo engineer or scientist. It also emphasizes that, if he or she is not discovered early enough and encouraged to complete required courses in high school, the chances are he will find it difficult to succeed at the university of his choice. The booklet lists the subjects and courses which are "musts" in high school. In addition, it suggests other academic and associated activities which help to develop the embryo engineer or scientist.

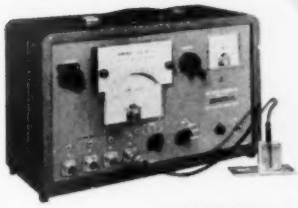
Commenting on the new booklet, Dr. B. D. Thomas, Battelle's president, said: "It represents the best thinking of a number of educators, guidance counselors, psychologists, engineers, and scientists, and it is directed primarily toward parents. With the heavy demands on our educational system, many parents have a vital interest in helping their children to select a career and prepare for it. In our complex age of specialization, providing parental guidance and encouragement is not an easy matter—even for the most conscientious parents. We hope this booklet may help parents to help their children."

The booklet further covers such subjects as (1) where to seek specific counsel, (2) possible financial aid for the college-bound youngster, and (3) possibility of a student working his way through college.

♦

ATLAS EXTENDS CORROSION STUDY OF REINFORCED POLYESTER EQUIPMENT

Atlas Chemical Industries, Inc., has launched a unique user-participation field testing program to enlarge the scope of present knowledge of the resistance of bisphenol polyester resin to the myriads of corrosive fumes and liquids used in industry. The study, carried right into the processing plant under normal operating conditions, is being undertaken to fill existing gaps in data on the chemical resistance of reinforced plastic equipment. There has been a fast-growing trend toward the use of this equipment in many fields, including chemical and metal treating.



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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
SEL-REX CORPORATION
Nutley, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

2,989,006, 6/20/61—WORK TRANSFER DEVICE—D. Borodin, assignor to Allied Research Products, Inc., Detroit, Mich.

An apparatus for transferring a work rack from one hooked supporting device to another is claimed.

19 claims, figure.

♦

2,989,418, 6/20/61—PROTECTION FOR Zn AND Al SURFACES—R. Harbaugh, assignor to Inland Steel Co., Chicago, Ill.

Articles having zinc or aluminum (alloy) surfaces are coated with an alkali metal silicate which is impregnated with chromic acid.

26 claims, figure.

♦

2,989,421, 6/20/61—GAS PLATING—L. Novak, assignor to Union Carbide Corp., New York, N. Y.

Alumina is deposited on a refractory substrate by heating the substrate to 1200F to thermally decompose an organo-aluminum compound in contact therewith in the presence of air and 1–10 per cent water.

2 claims, figure.

♦

2,989,427, 6/20/61—DYEING ALUMINUM—J. Noonan and J. Loughlin, assignor to Allied Chemical Corp., New York, N. Y.

Forming a colored layer on aluminum and alloys thereof can be done by treating with a chromate solution containing a lake-forming substrate, thereafter dyeing with a cationic dye.

7 claims.

♦

2,989,060, 6/20/61—PLATING MACHINE—V. Finston, assignor to The Meaker Co., Chicago, Ill.

A processing machine for advancing through a series of processing stations is described.

12 claims, figure.

♦

2,989,445, 6/20/61—ANODIZING—A. and J. Lloyd, assignors to Lloyd Metal Mfg. Co. Ltd., Orillia, Ontario, Canada.

A process for anodizing one side of an aluminum sheet is claimed.

♦

2,989,446, 6/20/61—ELECTROPLATING—M. Hammond and G. Bowman, assignors to Rockwell-Standard Corp., Pennsylvania.

A method of plating a nickel-zinc alloy from a bath containing 8–10 oz/gal of Ni and 6–8 oz/gal Zn and high in chlorides uses periodic reverse current to provide a high Ni-Zn alloy.

16 claims.

♦

2,989,448, 6/20/61—PLATING BRIGHTENER—Daniel France, 1650 W. Third St., Brooklyn, N. Y.

A brightener for brass, copper-tin and copper baths is made by dissolving in water to make one gallon: 16 oz NaOH, 6 oz As_2O_5, 0.6 oz lead subacetate, 3 oz Na_2Sn_3O, 0.2 oz V_2O_5, 1.6 oz disodium salt EDTA, and 0.2 oz of an alkyl-aryl amine type wetting agent.

8 claims.

♦

2,989,449, 6/20/61—ZINC PLATING—R. Mackey and D. Swalheim, assignors to E. I. du Pont de Nemours & Co., Wilmington, Del.

A liquid additive for cyanide zinc plating baths contains: 10–20 per cent of alkali metal thiocyanate, 5–25 per cent of an alicyclic alcohol or ketone, 2–10 per cent of a protective colloid, 6–10 per cent of a water miscible aliphatic (1–6 C's) alcohol, 0.5–1 per cent of polyvinyl alcohol, 5–25 per cent of an aromatic aldehyde (anisaldehyde, veratraldehyde, hydoxybenzaldehyde, piperonal) and 20–70 per cent water.

7 claims.

♦

2,990,293, 6/27/61—RUSTPROOFING—H. Toulmin Jr., assignor to the Commonwealth Engineering Co., Dayton, Ohio.

Heat metal articles to 500–1500F to cause formation of a microporous surface, bombard with zirconium, titanium or zinc particles of the diameter of 0.5–3 microns, then cool.

4 claims.

♦

2,990,295, 6/27/61—DEPOSITION OF ALUMINUM—E. Breining, et al. assignors to Union Carbide Corp., N. Y., N. Y.

A vapor deposition method is claimed wherein an organo-aluminum compound is decomposed upon a heated substrate, the improvement being the addition of 0.01–0.2 mol per cent of an oxidizing agent based upon mols of the organo-aluminum compound.

10 claims, figure.

♦

2,990,296, 6/27/61—PLATING METAL-BORON ALLOYS—R. Hoke, assignor to Callery Chemical Co., Pittsburgh, Pa.

A method of chemical plating with boron-metal alloys consists in bringing an object into contact with an aqueous solution containing salts of cobalt and nickel and a compound selected from the group of 2° and 3° amine boranes in the ratio of 0.1–3.0 wt per cent of borane to 0.02–6 wt per cent of metal in terms of concentration.

8 claims.

♦

2,990,342, 6/27/61—MAKING GUN BARREL—George Sullivan, 3085 Lake Hollywood Dr., Hollywood, Calif.

The barrel is machined from aluminum, providing a chamber and a bore axially of the blank, inserting the barrel in an electrolytic bath and gradually raising said barrel from said bath while passing a current through said bath whereby said bore is coated throughout its length with a coating formed from the base material at a controlled growth to effect a tapered bore.

2 claims, figure.

♦

2,990,343, 6/27/61—CHROMIUM ALLOY PLATING—William Safranek, assignor to USA (Army).

A chromium alloy plate can be electrodeposited from an aqueous bath containing 20–75 g/l of Cr^{+++} ions, an alkali metal salt providing 10–150 g/l of alkali ions and the salt of at least one alloying metal (0.6–2.5 g/l of iron, 0.1–1.0 g/l of nickel, 0.1–1.0 g/l cobalt).

4 claims,

♦

2,990,344, 6/27/61—CADMIUM PLATING—P. Vlannes, Washington Forest, Md. and Simon Strauss, Washington, D. C.

A cadmium bath is claimed containing 0.5–2 molar cadmium salt to which is added triethanolamine to make the amine: Cd ratio 1:1 to 4:1. The *p*H is 7 to 10.

5 claims.

MAIL BOX

SIR:

Rama Char and Vaid in Table V of their paper "Electrodeposition of Copper-Tin Alloys from the Pyrophosphate Bath" in the August 1961 issue of PLATING, page 871, summarise the results of an X-ray examination of electrodeposited copper-tin alloys and it is reported that alloys in the composition range 42 to 58 per cent copper had a two phase $\sigma + \eta$ structure. In addition, for one composition (54 per cent copper) a deposit obtained from a stannade-cyanide bath had also been examined with similar results. These findings are not in agreement with the results of Smart, Angles and Robins[1] who have recently published the results of a structural investigation of a range of copper-tin alloys electrodeposited from a stannade-cyanide bath. In this latter work a wide, single phase η range was found from about 32 to 50 per cent copper; the σ phase was not detected in any of the electrodeposited alloys. This difference between the two investigations is surprising since the compositions of the stannade-cyanide baths employed and the plating conditions were very similar although it is possible that small differences in the plating procedure may have influenced the crystal structures of the deposits.

An alternative explanation is possible, however. Although the crystal structure of the various compounds in the copper-tin system are, for convenience, indexed on different crystal systems, the structures, in fact, differ little one from another and mis-interpretation of X-ray powder patterns is easily possible. This is shown up clearly by the results of Rooksby[2] who originally stated that the σ phase was present in speculum deposits and Rama Char and Vaid considered that their own results were in keeping with Rooksby's findings. In a subsequent publication,[3] however, Rooksby found that the speculum alloy could be interpreted as η (Cu_6Sn_5) structure with a considerably modified composition in agreement with the conclusions of Smart, Angles and Robins.[1]

Perhaps the authors of the present paper would care to consider whether they also have mis-interpreted their results in the same way as Rooksby did in his earlier publication and whether a more correct interpretation might not be that the deposits under discussion, were in fact, single phase η with same inhomogeneity of composition in the η phase.

[1]Smart, R. F., R. M. Angles, D. A. Robins, J. Inst. Metals, *89* (1961) 349.

[2]Rooksby, H. P., J. Electrodepositors' Tech. Soc., *26* (1950) 119.

[3]Rooksby, H. P., J. Electrodepositors' Tech. Soc., *27* (1951) 153.

DR. D. A. ROBINS
Chief Metallurgist
Tin Research Institute
Greenford, Middlesex, England

SIR:

The authors are thankful to Dr. D. A. Robins for his discussion. The X-ray studies have not been carried out by us in a detailed manner, but only to supplement the electrochemical data. Misinterpretation of X-ray powder patters cannot be ruled out as pointed out by him. We will certainly bear in mind the valuable suggestions of Dr. Robins when taking up this work in a comprehensive manner.

T. L. RAMA CHAR
Professor of Physical Chemistry
Indian Institute of Science
Bangalore 12, S. India

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48' x 10' Straight line, end buffing, Andrew Plocher & Autolite, 1950 ..... $2500
67' x 5' Automatic, Divine Brothers, 1946 ..... $4000
POLISHING MACHINES, END TYPE, STRAIGHT LINE
48' x 10' Fred Christen & Son, 1946 ..... $2500
57' x 10' Fred Christen & Son, 1946 ..... $2500
POLISHING MACHINES, FLAT
24", 2 roll vertical pinch roll, Hill Acme Co., 1956 (10) ..... $5000 Ea
36", 2 roll vertical pinch roll, Hill Acme Co., 1956 (2) ..... $9500 Ea
BELT POLISHING UNIT
G-3 Polishing belt head and idler machine, Acme Mfg. Co., Serial #12942, 1956 ..... $300
#6-72, Grinding & Polishing Machinery Corp., 1959(4) $250
POLISHING MACHINES, HORIZONTAL RETURN TYPE, STRAIGHT LINE
80' Acme Mfg. Co., 1956 (2) $3000
100" Acme Mfg. Co., 1956 (2) $3500
WASHING MACHINES
Cincinnati 5 stage spray washer, Belt Conveyor 129'0" x 11'6" x 7'6", Serial #BS-1212-C2, 1960 ..... $14,500
30", 11'x101'x8', N. Ransohoff, Serial #8011, 1950 .. $18,000
POLISHING, ROTARY
18' x 3' Acme Mfg. Co., 1946 (3) ..... $2000 Ea
40" dia. continuous, Acme Mfg. Co., 1954 (5) .... $1500 Ea
8' x 36" Acme Mfg. Co., 1956 (2) ..... $3000 Ea
21'6" x 3' Acme Mfg. Co., Serial #7712, 1950 .. $2500 Ea
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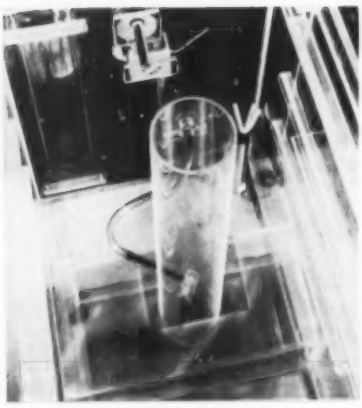
EQUIPMENT AND SUPPLIES



E—1201. CORROSION TEST CABINET—A new line of Singleton "Opti-mist" corrosion test cabinets is offered by The Singleton Co. Featured is the firm's in-cabinet, moveable "Opti-mist" fog generator-solution reservoir. It is the first such accessory to successfully create uniform, free settling fog for proper collection to meet official requirements, according to the company. Generator tube stands upright in reservoir which water-seals bottom against fog recirculation and other causes of variables. Solution and cabinet temperatures are constant. Adapts to old and new cabinets.

As an alternate to the generator, a three-dimensional fog baffle, adjustable for directing fog as desired is attached to reservoir cover. Cabinets are available in small to king-size models, plastisol-lined stainless, plastisol-lined plain steel, transparent H-T Plexiglas, for heavy-duty service, condensing or non-condensing.

E—1202. PLATING CONSOLE—A self-contained plating console designed for plating printed circuits, and for small cleaning or pickling operations, or bright dipping, has been introduced by the Davies Supply & Manufacturing Company of St. Louis, Mo.

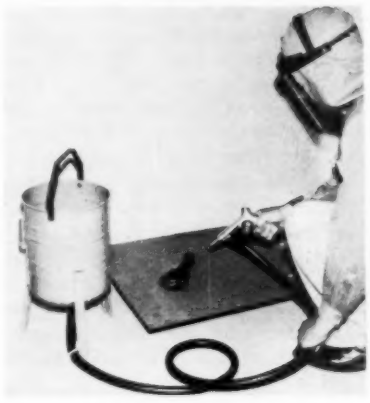
The Davies console is complete in one unit, ready for quick installation, merely by setting it in a chosen spot and making single water, electrical and drain connections. Its prefabricated tanks and floor mountings are heavily coated with Davynol plastisol at the factory, where piping

and wiring are also built in. No additional equipment or installation is necessary. The typical Davies Console occupies 6 by 4 ft of floor space, with tanks at normal cabinet height.

E—1203. DUMET CLEANER—Fidelity Chemical Products Corp., has introduced a new cleaner for Dumet wire. Cleaner No. 206 removes the borate coating and the copper oxides formed by the fusing of the Dumet wire to glass, and is said not to cause undercutting or attack on the copper even after long immersion period.

Safe to handle, the No. 206 leaves the wire clean and bright, ready for electroplating, hot tin dipping, or other operations.

E—1204. SAND BLASTER—Frederic B. Stevens, Inc. has introduced a new portable sand blaster for removing rust, paint and chemicals, cleaning core boxes and patterns, and for blasting jobs that formerly required larger and more complex equipment.



This new sand blaster is said to operate with any hard, dry abrasive material, and can be attached to existing air sources. No special sand blasting rooms are necessary as the abrasive blast is confined to a small area. A simple drop cloth placed under the work permits reuse of the abrasive.

The blaster comes with pistol-grip type blast gun, extra air jets and nozzles, six feet of hose (other lengths are optional), and a 12-quart capacity abrasive container. A durable hood and face shield are also included.

E—1205. ANODE STORAGE UNIT—A storage unit, Erecta-Shelf, product of the Metropolitan Wire Goods Corp., provides compact shelving for the storage of plating anodes.

Thirteen anodes (weighing 42 lb each) can be stored per shelf, for a total of 546

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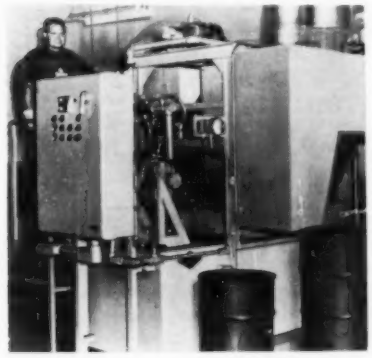
December 1961. Do not use after February 15, 1962

lb. Though Erecta-Shelf has been tested to 1000 lb per shelf, it is light enough in weight to be assembled by one man. No nuts, bolts or special tools are required. Entire units fasten end-to-end at right angles, back-to-back and even stack for added height.

E—1206. DRUM WASHER—The Alvey-Ferguson Co., recently introduced a new compact, batch type drum washer. It has a capacity of three cubic feet per batch and can be operated by one man.



Parts, to be cleaned, enter the drum through a chute and are subjected to a high-pressure spray. During the washing cycle, the parts are gently tumbled by the helical spiral in the drum so that all surfaces are exposed to the cleaning action. Cleaning solution, oil, chips, and impurities are drained off through perforations in the drum. A pre-determined rinse cycle is then followed by a drying cycle. The entire sequence is controlled by an automatic timer that also unloads the drum automatically when the parts are thoroughly clean and dry.

E—1207. ALUMINUM FINISH—An entirely new and revolutionary baking finish for aluminum, Uni-Clad formula AD, virtually eliminates special metal treatment, yet shows adhesive and protective qualities, according to the announcement by Universal Paint & Varnish, Inc. Available in clear or colors, from high gloss to flat, it is said to have good color retention. Samples are available.

E—1208. ROSIN FLUX REMOVER—A new rosin flux remover, known as Reflux, is 35 per cent faster in operation than carbon tetrachloride and similar materials, as well as lower in cost, according to the manufacturer, Supracote Development Laboratory, Inc.

Although designed primarily to improve reliability of a critical procedure in the manufacture of printed circuit boards, Reflux can also be used for quick, economical cold-cleaning of greases, waxes, dirt-films, etc., from all metallic surfaces.

E—1209. RUST REMOVER—Introduction of Wyandotte Phos-It in unbreakable, plastic, 1-gal containers with "large-grip" handles, 4 to the case, is announced by J. B. Ford Division, Wyandotte Chemicals Corp.

The attractive, light-weight container features ease of handling and convenience of use along with compact storing. A durable and reusable container, breakage is eliminated. Liquid content is visible through plastic for easy control of use, or for inventory purposes.

A concentrated, all-purpose metal conditioner and rust remover, Phos-It is a phosphoric-acid-type detergent used for removing tarnish and corrosion from aluminum, preparing aluminum, iron, steel, zinc, other metals for paint. For volume users, Phos-It also is available in 30-gallon, liquipak, fiber drums.

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TRADE LITERATURE

L—1201. COATING GAGE—A new brochure, just published by Twin City Testing Corp., introduces the Type EC Permascope for non-destructive measurement of (1) a non-conductive coating on a non-ferrous base metal such as aluminum or copper, (2) a non-ferrous coating on a non-ferrous base, (3) a non-ferrous coating on a non-conductor, and (4) conductivity of a non-ferrous metal.

As well as containing descriptive information, specifications and prices for the new instrument, the brochure includes details on Type ES Permascopes for gaging coatings on iron and steel plus a technical discussion of non-destructive thickness testing.

L—1202. AUTOMATIC SPRAY NOZZLES—A new Bulletin 115 has just been issued by Spraying Systems Co., giving complete information on AutoJet automatic spray nozzles for hydraulically atomizing sprays at operating pressures up to 6/90 psi. Automatic spray control is obtained by an air actuated cylinder that is an integral part of the overall nozzle. On-and-off operation of the nozzle may be synchronized with any work feed or production cycle. In addition to the basic design, nozzles of this type are also offered with automatic clean-out needle and with extensions. A typical installation is schematically illustrated and described along with accessory equipment.

L—1203. ABRASIVE FINISHING—New technical data sheet on abrasive finishing methods for thermoplastic and thermosetting plastics has been made available by The Lea Manufacturing Co. This sheet gives complete data on abrasive grits and grades, wheel speeds, type of buff recommended and buff speed and surface speed.

L—1204. HYDROXYACETIC (GLYCOLIC) ACID—A technical bulletin has just beep published by E. I. du Pont de Nemours & Co., Inc., about hydroxyacetic acid and its established and potential uses. Among the many uses enumerated are copper brightening, decontamination cleaning, electroplating, electropolishing, pickling, cleaning and chemical milling of metals, water system treatment, new vapor cleaning techniques.

L—1205. AUTOMATIC ULTRASONIC CLEANING—A comprehensive brochure is being offered by Autosonics, Inc., describing their line of automated ultrasonic machines. The entire line is self-sufficient, features the air feedback solvent control system, maintains own solvent or water level, automatically distills solvent to keep it continuously clean, and operates automatically.

L—1206. LIQUID ADDITIVE—Frederick Gumm Chemical Co., Inc., has announced the availability of technical bulletin 551 describing new Clepo Rinsade A, a liquid additive for use in water rinse tanks. It is said to aid in removing water, and as a result eliminates drying stains and minimizes "spotting out." When used on otherwise untreated steel, it provides a film which has mild rust inhibiting action according to the manufacturer.

L—1207. BUFFING COMPOUND CLEANER—A new concept, invert emulsion cleaning, is claimed by Enthone, Inc., for the removal of heavy buffing compound deposits. Enthol V-240, a new product, is said to be unlike ordinary emulsion cleaners in that it will invert at operating temperatures to a water-in-oil emulsion. This enables the heavily soiled work to be acted upon by 100 per cent hot solvent.

Literature is available describing the new solution which is intended as a precleaner prior to pre-plating cycle for removal of buffing and polishing compounds, oil, grease, drawing compounds, and grinding lubricants. It is claimed to remove soils from steel, aluminum, copper, zinc die castings, and most other metals without reacting on the basis metal.

L—1208. RUST/SCALE REMOVER—A new bulletin describing Everite, a fast-acting rust and scale remover, is available from The Diversey Corp.

Diversey reports that Everite is for removing rust from finely finished parts without etching or acting upon the metal surface and from metal surfaces being prepared for repainting. It will not change dimensions of forgings and castings, the bulletin states.

L—1209. POWER SUPPLIES—Just released by American Rectifier Corp., is a 44-page catalog covering their complete line of both standard and custom engineered power supplies, ranging in size from 50 watts to 5000 kw. Over 3000 models are listed and described in this illustrated 2-color catalog.

There are many features, such as: a glossary covering terms used most frequently in power supplies; a basic power supply and control feature evaluation chart which gives an evaluation as to what type of power supply is best for what features; an electroplating guide which gives the recommended rectifier power output for common plating applications. Information on rectifier circuits, suggested applications for various units, diagrams, and other information designed for both the technical and non-technical man are included.

L—1210. COOLING SYSTEM PRETREATMENT—Technical data file C4 on Nalprep pretreatment for preparing and protecting new or freshly cleaned metal surfaces in cooling water systems, contains a process bulletin which tells when, where and how to use new Nalprep, technical data sheets on specific products and reprints . . . with laboratory data and case histories. It is offered by Nalco Chemical Co.

L—1211. ELECTROSTATIC GENERATORS—New 8-page brochure available from SAMES describes the company's line of electrostatic generators. Complete specifications for these dc power supplies are included, covering models ranging from 50 to 600 kv output. Features, applications, and principles of operation are included. A series of schematics illustrate the text.

As an accommodation to its readers, PLATING MAGAZINE will be glad to channel to the companies involved, any readers' requests for copies of these latest bulletins and catalogs. Either circle the correct key number on the convenient Reader Service coupon below, or write PLATING MAGAZINE on your letterhead (state correct key number).

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PERSONALS

(*Continued from page 1326*)

Mr. Latt, a graduate of the University of Vermont, will serve the metal industries in the south Buffalo, New York area, where he joins E. K. Billington and J. P. Geary.

Mr. Moulton, a graduate of the University of New Hampshire, where he majored in chemistry, has been assigned to the state of Vermont.

Both men completed an eight-week training program at Oakite's New York laboratories and in the field before undertaking their new assignments.

♦

DANIEL R. SAVAGE has been named as service manager for the American operations of SAMES (Société Anonyme de Machines Électrostatiques), French electronics firm and pioneer in the field of electrostatics.

In his new position, Mr. Savage will be responsible for management of all service operations on installations and equipment throughout the U. S. This includes the company's high voltage power supplies, particle accelerators and electrostatic spray equipment. He will make his headquarters at 30 Broad Street, New York City.

♦

PETER C. NOY has been appointed resident engineer at Nicromatic, Ltd., of Toronto, Canada by Enthone, Inc. Nicromatic is the licensee and distributor of Enthone products in Canada.

Mr. Noy attended Queens University in Kingston, Ontario, Canada prior to obtaining experience as a plant manager, planning engineer, and chief chemist. He spent the past two years as chief chemist for Nicromatic, Ltd.

P. C. Noy

C. J. Martin

CHARLES J. MARTIN has been named Eastern regional sales manager of Kelite Corp.

Overseeing sales on the eastern seaboard, Mr. Martin will have headquarters in the Berkeley Heights, N. J. facility.

His career in sales started with W. H. Harman Corp. where he was first a sales engineer and then a district sales manager. For the last 14 years he has been associated with Wyandotte Chemicals Corp.

A native of New York City with sales and sales management experience in the eastern and midwestern states, he is a member of the American Electroplaters' Society.

♦

ALLAN ELSTON has been named eastern regional sales manager for The Diversey Corp. His headquarters will be at the company's Newark, N. J., offices.

Since joining Diversey, Mr. Elston has

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A bonafide example of the advertiser's proposed mailing must first be received and screened by PLATING. If mailing assignment is accepted thereby, the entire quantity must be shipped by the advertiser to PLATING MAGAZINE's Newark, N. J. office, pre-stuffed, for PLATING addressing and mailing. No mailing of less than a thousand pieces is acceptable. For further, fuller details, including costs, write or call Thomas W. Lowe, Production Manager, PLATING MAGAZINE, American Building, 443-445 Broad Street, Newark 2, N. J. (Telephone HUmboldt 2-3400).

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served as assistant manager and acting manager of Diversey-France and as general manager of Diversey-Wilmington in Sao Paulo, Brazil, his most recent position. As eastern regional manager, he will be responsible for all sales activities in Diversey's Eastern and New England divisions.

He is a graduate of Massachusetts Institute of Technology with a degree in business and engineering administration.

♦

DR. MERTON M. BECKWITH has been appointed vice president and technical Director, **PAUL R. STUART,** vice president and general manager and **WALTER FRIEDE,** manager of the customer service laboratory of R. O. Hull & Co., Inc.

Dr. Beckwith joined ROHCO after 25 years in the metal finishing industry, the last 15 with Harshaw Chemical Co., where he had advanced to electroplating division manager, supervising research and development, field service, and other activities of that division. As a director of Harshaw Chemical Ltd., London, England, a wholly owned subsidiary which was established and operated under his direction, he also supervised foreign electroplating activities for the firm. He is well known as author and speaker on developments and practices in electro-finishing and plating. Among numerous technical contributions are the duplex nickel plating process, on which he holds foreign patents. He has twice won the annual Dorothy Hermine Proctor Award of the American Electroplaters' Society, and is an active member of the American Electroplaters' Society, American Society for Testing and Materials, American Society for Metals, Electrochemical Society, Institute of Metal Finishing (British), Phi Lambda Upsilon (Chem. honorary), Sigma Xi (Science honorary), and Alpha Chi Sigma.

Dr. Beckwith is presently emphasizing research and development in expanding processes and field technical facilities. Foreign activities are also being extended under his direction.

Dr. M. M. Beckman

P. R. Stuart

Mr. Stuart, ten years with ROHCO, advanced from office manager to general manager; then to his present post. He will continue to manage corporate activities.

Walter Friede is responsible for analytical work relative to solving special plating problems. Bringing technical service facilities closer to the field is part of his program. Mr. Friede was a chemist at Brookhaven National Laboratories and before that was plant chemist for Circle Wire and Cable. He holds memberships in American Chemical Society and American Electroplaters' Society.

W. Friede

D. W. Oakley

H. E. HIRSCHLAND has been designated as group vice president with the Commercial Development and Research Divisions of Metal & Thermit Corp. **B. W. WEBER** is appointed group vice president in charge of the manufacturing, employe relations and administration divisions. **J. L. OBERG** is group vice president in charge of the minerals, ceramics and welding divisions; and **D. W. OAKLEY,** is group vice president for the chemicals, coatings and plating divisions of M&T.

H. E. Hirschland started with M&T in 1941 as a process engineer in the then-newly-centralized research department. He has been active in research, production, sales and commercial development assignments since that time.

A native of New York City, Mr. Hirschland graduated from Dartmouth College, class of 1939, with a Bachelor's degree in chemistry. He received the MS degree in chemical engineering in 1941 from MIT.

Mr. Weber joined M&T in 1949 as general plant manager in the East Chicago plant. In 1952, Mr. Weber was appointed production manager in M&T's New York executive offices, and in 1956 he was named manager of manufacturing. In 1959 he was appointed vice president of manufacturing.

Mr. Oberg joined M&T in 1955 as technical advisor to the president. In 1959 he was appointed general manager of the metals & minerals division, and in 1960 was elevated to vice president.

Mr. Oberg is also a vice president of International Titanium Corp. He received the BS degree in metallurgical engineering from Lehigh University, and completed the training course for senior executives at MIT.

Mr. Oakley started with M&T in 1947. Previous to being appointed general manager of the coatings division in 1960, he was a production manager of the manufacturing Division. He was appointed vice president in 1960.

He received the BS and MS degrees in chemical engineering from Columbia University, and later attended the Columbia University School of Business.

YOUR PLATING MAGAZINE QUESTIONNAIRE

So as to assure that PLATING MAGAZINE's classification of its subscribers by number, function and geographical location is constantly and consistently up to date for Audit Bureau of Circulations audit, a Return Sheet was, some time ago, issued to each subscriber internationally. If you are among those relatively few who have not yet accomplished and returned yours, your cooperation in doing so promptly will be appreciated by AES and PLATING.

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OFHC anodes	42.50
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ZINC, ball anodes, 2000 lb lots (for elliptical add 1¢ per lb)	18.25
NICKEL, 99 pct plus, rolled carbon 5000 lb (rolled depolarized add 3¢ per lb)	$1.05
TIN, ball anodes, per lb, approximately	$1.26

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Primary Metals

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INDIUM, 99.9 per cent, per troy oz	$2.25
LEAD, New York, cents per lb	10.60
PALLADIUM, per troy oz	$24 to 26
PLATINUM, per troy oz	$82 to $85
RHODIUM, per troy oz	$137 to $140
SILVER, cents per troy oz	91.375

Chemicals

BORIC ACID, 100 lb bag N. Y.	12.10
CADMIUM OXIDE, 100 lb drum per lb	$1.70
CAUSTIC SODA, 100 lb, N. Y.	8.50
CHROMIC ACID, flake type, 100 lb drums	31.00
COPPER CYANIDE, 100 lb drum	65.90
COPPER SULFATE, 100 lb bags, per cwt	15.50
NICKEL CHLORIDE, freight allowed, 100 lb	47.50
NICKEL SULFATE, 5000 lb	31.00
POTASSIUM CYANIDE, 100 lb drum N. Y.	46.50
ROCHELLE SALTS, 100 lb	53.00
SODA ASH, 100 lb	9.10
SODIUM CYANIDE, 2000 lb	25.80
SODIUM STANNATE, 100 to 600 lbs	79.90
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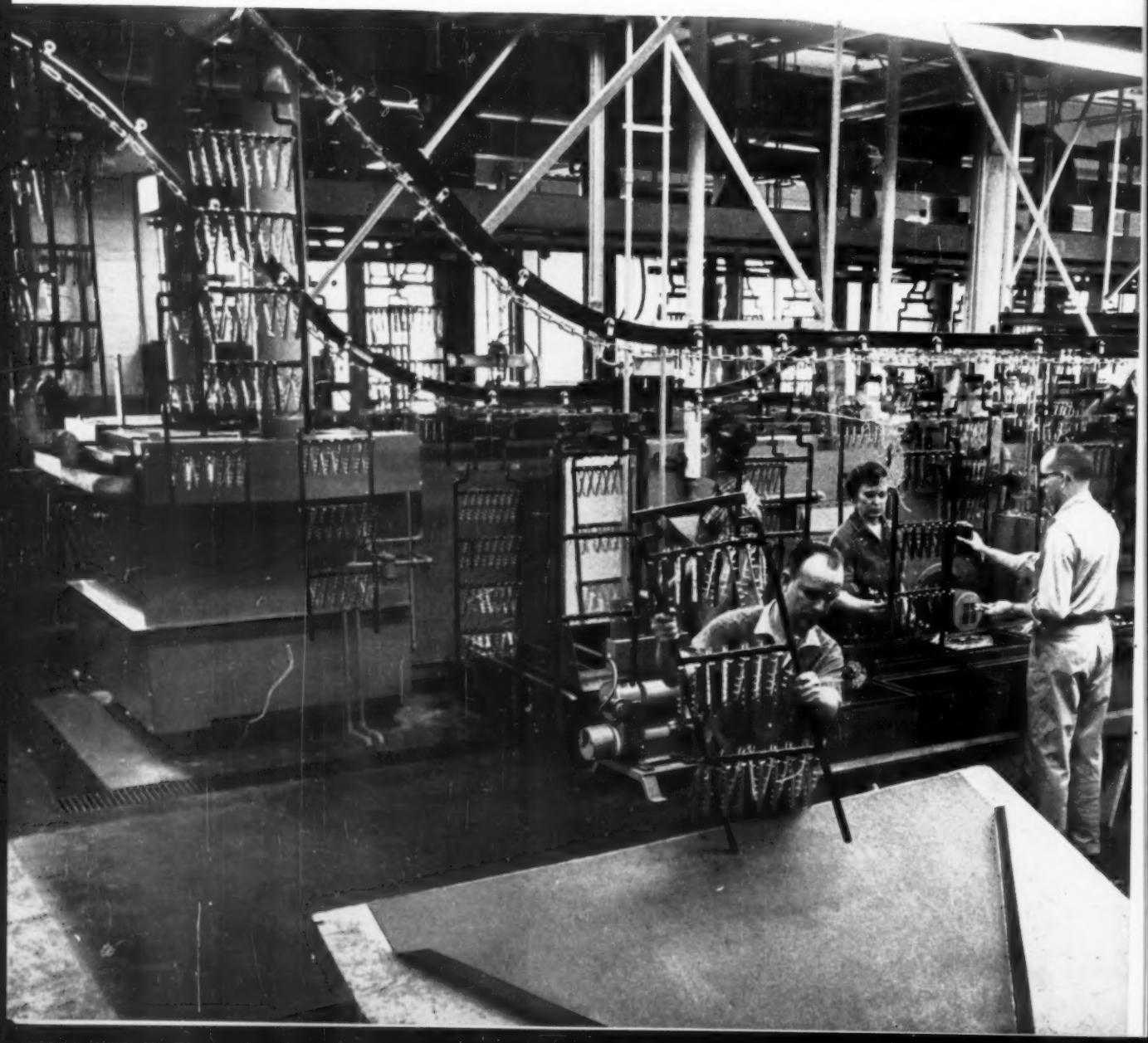

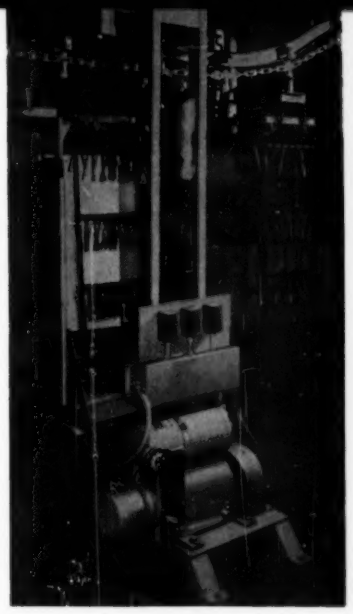

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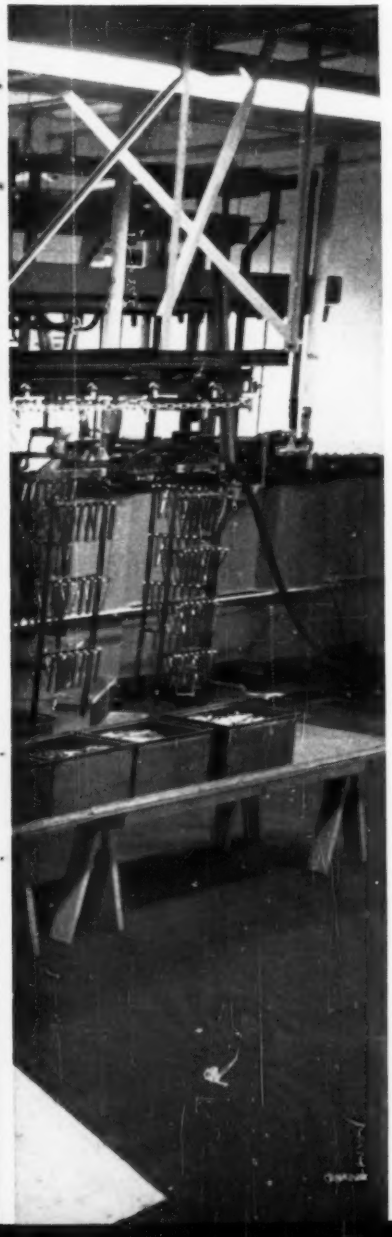

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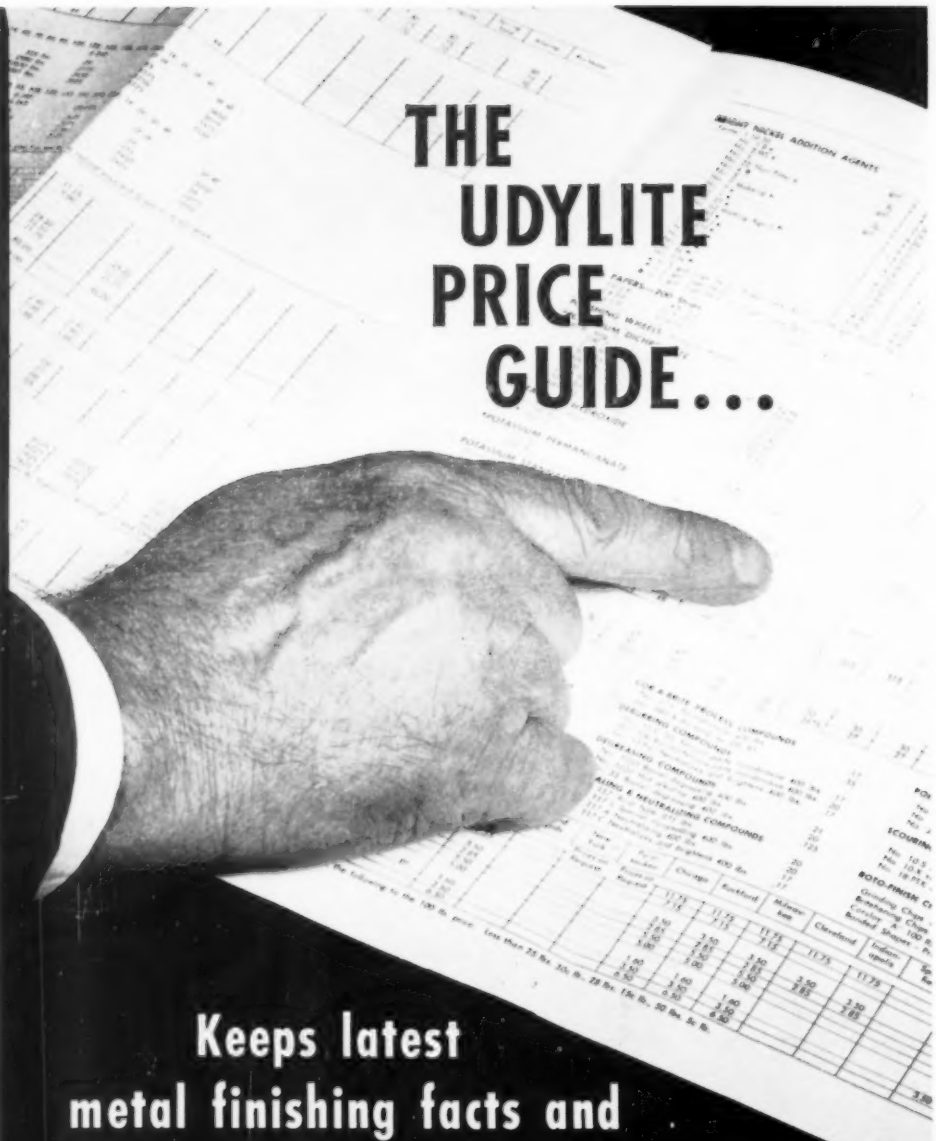

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HYDROGEN EMBRITTLEMENT IN METAL FINISHING

Edited by DR. HAROLD J. READ

Professor of Physical Metallurgy, College of Mineral Sciences
Pennsylvania State University

SPONSORED by American Electroplaters' Society, Inc. (AES), this book is based upon technical papers presented at the "Hydrogen Embrittlement in Metal Finishing" Symposium held at the AES's 47th Annual Convention, Los Angeles, California, July 24-28, 1960.

In addition to those papers, the Editor has written and included special material which deals with practical operating data, plant information and other facts of practical value to metal finishers and users of finished materials.

CONTENTS AND CONTRIBUTORS

1 *The Metallurgical Aspects of Hydrogen Embrittlement in Metal Finishing* by Harold J. Read.

2 *On the Mechanism of Transport of Hydrogen Across a Solution-Metal Interface* by Richard J. Barton.

3 *The Behavior of Hydrogen in Iron and Steel* by Maynard L. Hill.

4 *Measurements Pertaining to Hydrogen Embrittlement* by Cloyd A. Snavely.

5 *Detection and Measurement of Sorbed Hydrogen* by Samuel C. Lawrence Jr.

6 *A New Look at the Hydrogen Embrittlement of Cadmium-Coated High Strength Steels,* by Norman M. Geyer, G. William Lawless and Bennie Cohen.

7 *The Effectiveness of Metallic Undercoats in Minimizing Plating Embrittlement of Ultra-High Strength Steel* by Walter Beck and Edward J. Jankowsky.

8 *Control of Hydrogen Embrittlement by Plating from Cadmium Cyanide Baths Containing Nitrate* by W. F. Hamilton and Myron Levine.

9 *A Review of Some Studies in the Phenomena and the Control of Hydrogen Embrittlement* by Harold J. Read.

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EMBODYING the full text of each of the technical papers delivered by experts before the 48th Annual Convention of American Electroplaters' Society, Inc. (AES) held in Boston, Massachusetts, June 18-23, 1961—including all of each paper's charts, diagrams, graphs, tables and other illustrations, and the transcript of the discussion that attended the delivery of each such paper—the internationally awaited 1961 Edition of the AES's annual book, TECHNICAL PROCEEDINGS, has been completed. A copy has now or will very soon reach every AES member in good standing, globally, as an entitlement of AES membership.

A veritable treasure chest of technical knowledge on electroplating, metal finishing, organic coating and allied arts that conforms with the standards of AES's previous annual editions, TECHNICAL PROCEEDINGS (1961 Edition) also presents the full text of each of the technical papers on the Finishing of Aluminum, Magnesium and Beryllium that composed the "Finishing of Light Metals" Symposium, a feature of AES's 48th Annual Convention.

The 1961 Edition also presents in full, the text of the third annual "William Blum Lecture" that was delivered at the Opening Educational Session of that AES Boston Convention by Dr. Charles L. Faust (Battelle Memorial Institute), third annual winner of the AES Scientific Achievement Award, the Society's highest scientific honor.

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AES RESEARCH PROJECT NO. 15—PROGRESS REPORT ON THE DEVELOPMENT OF CORROSION TESTS FOR THE PERFORMANCE OF PLATED COATINGS by Walter L. Pinner, McGean Chemical Company, Project Chairman

ANODIC BEHAVIOR OF METALS IN CLEANING MEDIA—COPPER AND ITS ALLOYS, THE, by Samuel S. Frey, Oakite Products, Incorporated

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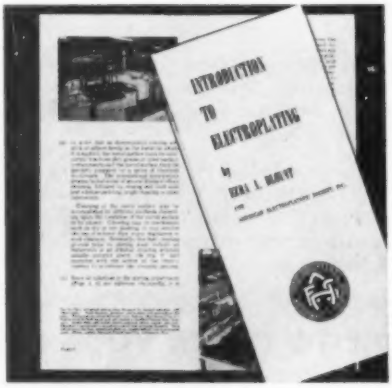

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BRANCH NEWS

Total AES Branches U. S., Canada, Australia, December 1, 1961—62.

BALTIMORE-WASHINGTON

Third Generation Pierdon Joins AES; Weisberg is Speaker

The first meeting of the 1961–1962 season was held at the Brentwood Inn, Baltimore, Maryland.

A large number of members and their guests enjoyed cocktails and a tour of the Inn's famous wine cellar of 20,000 bottles of rare wine prior to a delicious smorgasbord dinner.

Joseph Czernikowski, member of The Wine Counselors Guild, addressed the group concerning the origin, manufacture, types and history of wine.

R. Scott Modjeska of the Chicago Branch was present as a guest. **Henry A. Pierdon** was elected to membership. Witnessing his election were his father, **Arthur G. Pierdon** and **grandfather, Fred F. Pierdon,** one of the charter members of the AES.

Kenneth M. Huston, past national president, presented a Branch Past President's pin to Immediate Past President **Harold W. Scott.**

Featured speaker of the evening was **Alfred M. Weisberg,** vice president, Technic, Inc. Mr. Weisberg's subject was "Methods and Applications of Precious Metal Electroplating." Prior to beginning his featured presentation, Mr. Weisberg addressed his remarks to the ladies concerning the antiquity of the art of plating. A few highlights from his remarks: plating began about 200 years before the birth of Christ, an ancient Greek festival involving Anodus and Cathodus linked with Faraday and Volta's discovery of the battery were the beginning of electroplating, the first patent on plating was bought by the Czar of Russia and given free to the people, Napoleon's grandson established the first job shop in Russia and by 1850 employed 2500 persons, first gold plating was on copper plates for the dome of the cathedral and it is still in use. Portuguese brandy was ordered by the crowned heads of England to be supplied to platers as an antidote for cyanide poisoning.

Mr. Weisberg then presented his main subject, discussing various neutral, acid and alkaline gold plating bath formulations and characteristics, including a new bath just released several months ago.

Harold W. Scott
Secretary-Treasurer

BLUE RIDGE

Attendance at Meetings Shows Increase

One of the most successful meetings in the history of the Blue Ridge Branch was held in October in Charlotte. The second largest attendance ever recorded at a Branch meeting was attained. Forty-two members and guest attended. Visitors from Atlanta and Philadelphia were present. Attendance at the two meetings held so far this year is well ahead of last year and should continue to be good with the interesting programs planned.

At the business meeting an election was held to select Delegates for the 1961–62 fiscal. Those elected were: **Mike Milo, Dr. Nelson Murphy** and **L. C. Jackson,** Delegates; **Del Taylor, Bruce Wallace** and **Gerry Lordi,** Alternate Delegates. Five new members were elected.

Branch President Milo presented Bruce Wallace with a past presidents' pin. During the presentation Mike cited the work Bruce did last year as president of the Branch and general chairman of the Dixie Regional meeting.

Donald H. McGee

BOSTON

Winsor Resolution Voted; Eisenberg is Speaker

Boston Branch met Thursday, October 5, at the Statler-Hilton with President **Marotta** in charge. Communications were read concerning Delegates, Honorary Membership and Scientific Achievement Award. A communication was read from Mrs. Felix Winsor and it was voted that **Manson Glover** present a resolution on the death of **Felix Winsor** at the November meeting.

Two applications for membership were approved. Delegates elected are **Hubert Foley,** Manson Glover and **George Swift** with Alternates **Louis Gagnon,** George Marotta and **Lloyd Ray.**

Roger Roy presented **Philip H. Eisenberg** of Electronic Metals and Alloys, Inc. of Watertown, Mass. speaking on "The More Interesting Aspects of Semi-conductor Parts Plating." Various types of parts were discussed and exhibited as well as methods of handling and plating. Slides were used to show the variations in size and characteristics. A new electroless gold formulation that actually works was mentioned as being published in the August issue of the *Journal of the Electrochemical Society*. Electroless nickel was also discussed, with clarity of solution a prime necessity for satisfactory deposition.

George P. Swift
Secretary

BUFFALO

Water Soluble Resins Explained by Pocock

The Buffalo Branch held its October meeting Friday, October 13, at the Peacock Inn in Mayville, N. Y., with 30 members and guests in attendance.

Guests of the evening introduced by President **John Donaldson** were **Jack Henderson, Larry Felton, Paul Westman, Harry Carlson, Lyle Petersen** and **A. C. Hart.**

Two men were elected to membership. **Dick Travis** reported on membership changes.

Chuck Fotheringham reported on the annual Christmas Party to be held Saturday, December 9, 1961 at the Red Lobster. It will be held in place of our regular business and technical meeting in December.

Mel Stachura announced that the publicity committee is hoping to obtain a spread in the Buffalo Evening News on the Buffalo Branch of the AES.

Sick committee members **Ray Kilroy** and **Bert Kirchoff** reported that all members were in good health to the best of their knowledge.

After the business session, Educational Chairman **George Wolf** introduced **Walter Pocock,** development engineer, Allied Research Products, Inc., who spoke on "Water Soluble Resin Systems."

The January meeting will be held Friday, January 5, details to be announced.

Robert E. Lienert
Secretary

CAPITOL DISTRICT

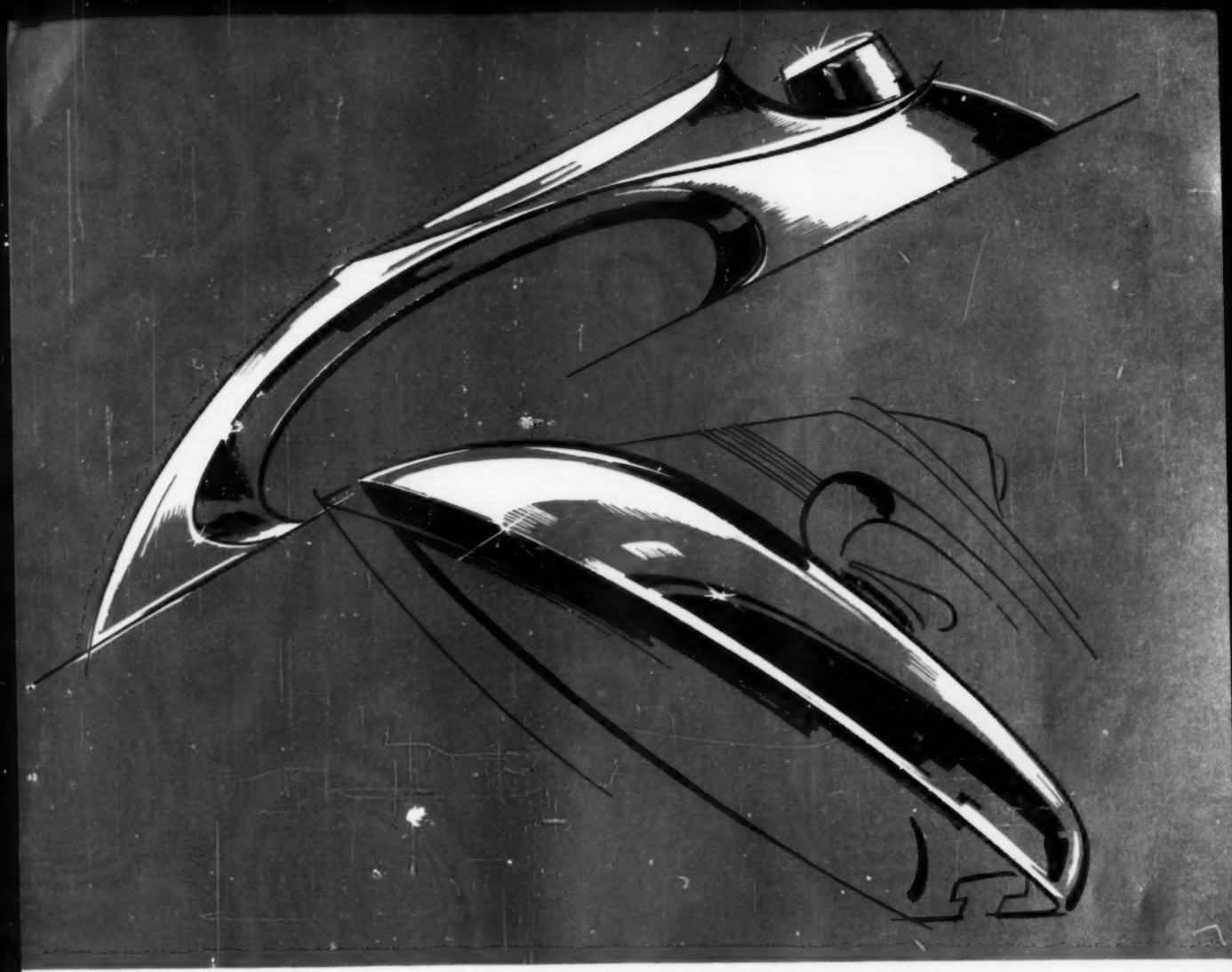
Bellinger Discusses Zinc and Cadmium Coatings

The first meeting of the year on Sept. 11 was called to order by the incoming president, **E. Frieberg.** A vote of thanks for a job well done was given to **Z. Nash,** the outgoing president.

Bob Wolfe gave a brief report on the 1961 National Convention held at Boston. A membership committee was appointed consisting of **A. Eisner,** chairman, and **F. Quackenbush.** Guests present were **H. Murano,** Oakite Products and **A. Wylde,** Sprague Electric.

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.



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Delegates appointed for the National Convention are: **F. Infield, D. Dagnolia,** and **J. Courtemanche;** alternates **E. Frieberg, R. Hill,** and **E. Le Gere.**

Mr. Courtemanche introduced the guest speaker, **Kenneth Bellinger** of Conversion Chemical Corp., who interested the members with his informative talk on zinc and cadmium coatings and the dyeing of them. Color slides picturing various examples were shown by Mr. Bellinger. At the conclusion of his formal presentation and discussion, he showed some slides he had taken in Germany and England earlier in 1961.

M. Opar
Secretary

CHICAGO
Branch Award for Best Article; Rudenga, Putek and Hendricks Are Speakers

The Branch held the monthly meeting on Friday, October 13, at the Chemistry Building of Armour Research Foundation, 35th and Dearborn Streets. Three applications for membership were turned over to the board of managers and one application was approved. **Mr. Glab** read a letter regarding the start of a new Branch of the AES at Cedar Rapids, Iowa, with the first meeting to be held on Thursday, November 16, at the Hotel Roosevelt.

The committees for the banquet and Ladies Nite will have a preliminary report for the next meeting. **Si Gary** reported that the new roster for the Branch including the sustaining members will be ready for printing in the near future. An award of $25 will be given for the best article on "Cost Saving Ideas in the Plating Room." All members were urged to send in their ideas and try to win the award.

The October meeting marked the beginning of a series of short technical presentations, ten-minute duration, on shop operations, processing, solving of a problem, etc., prior to the regular technical program. **Ben Rudenga** and **Steve Putek,** of Bell and Howell, discussed "Automatic Polishing of Aluminum Die Castings to Close Tolerances." The desired finish on the casting was to resemble "satin-chromium" and was achieved by (1) three stages of polishing, (2) ultrasonic cleaning, (3) dipping in precipitating thinner followed by (4) painting the part with an enamel epoxy paint baked at 320-330F. **Art Bartmann** handled the question-and-answer period.

The guest speaker for the evening was **John A. Hendricks,** of Alcor Chemical Company, who spoke on the "Mechanisms in Bright Plating." Glue, cresol sulfonates were used as additives in the electrowinning of lead and tin. Wool was discovered as a brightener for a cadmium plating bath when a workman's sweater fell into the bath and disintegrated overnight. The dissolved wool acted as a colloid and produced brightening of the electrodeposit. Coffee was tried as a brightener for cadmium but without success but a coffee substitute, Postum, worked very well. Some of the cadmium hydrate, which was used to make the cadmium baths, produced brightening effects. It was later found that the hydrate was contaminated with nickel and refined the grain deposit.

Later casein, sulfonated castor oil and the aldehydes such as cinnamic and anise

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aldehyde were used as additives for cadmium plating baths. During a cadmium shortage, brighteners for zinc were produced which were mainly based on purification keeping the bath clean of heavy metals. Different aldehydes, aliphatic or aromatic, were reacted with formaldehyde to form resins which were soluble in the zinc plating bath. The resins acted as colloids to refine the deposit and produce brightness. Sulfur, found in the aromatic sulfonic acids, produced a leveling and brightening action when used in nickel baths. On analyzing the bright nickel plate, there was from 0.01–0.03 per cent of sulfur included in the nickel deposit.

The electron microscope has revealed that by the use of saccharin in bright nickel baths, that the brightness is caused by the lateral growth of the crystal or so called "flattening" of the crystal growth to produce leveling and brightness. Mr. Hendricks concluded his talk by saying that the mechanism of bright plating is being studied in a highly scientific manner and studies in the future will disclose the true mechanism of brightness. After a question-and-answer period he was given a rising vote of thanks for his interesting and informative talk.

Christopher Marzano
Publicity Chairman

CINCINNATI
Safranek Discusses Corrosion Resistance of Plated Coatings

Thirty-three members and guests were present at an October 25 dinner meeting at the Engineering Society. **Dick Evans** reported that the Ladies Night Christmas Party will be held on Wednesday, December 20. Two applications for membership were approved.

The speaker for the technical part of the meeting was **William H. Safranek** of Battelle Memorial Institute, and his topic was "The Corrosion Resistance of Electroplated Zinc Die Castings." His presentation was based on the results of a continuing research project sponsored by the American Zinc Institute. From laboratory and field tests it has been proven that outstanding corrosion resistance can be provided to zinc die castings by using the proper plating process. Two plating systems which have proved very successful are the duplex nickel with 0.01 mil of low-temperature, low-ratio chromium; and duplex nickel followed by 0.025 mil of microcracked chromium. The latter process has shown to be superior. Mr. Safranek also went into the theory of the corrosion process and why the above system gives better protection.

David L. Kaplan
Secretary

COLUMBUS
Peacock Talks about Plating Solutions

The Columbus Branch met at the Desert Inn on October 5.

James H. Peacock of the Duriron Co., was the guest speaker. His subject was "Metals and Plastics for Handling Plating Solutions." Mr. Peacock described and demonstrated with slides nine forms of corrosion: (1) general or uniform, (2) intergranular, (3) galvanic, (4) dezincification, (5) pitting, (6) concentration cell, (7) stress, (8) erosion, and (9) stray current attack. He then discussed materials that can be used for the various types of copper, chromium and nickel plating solutions.

Mary Fulmer
Secretary

DENVER
Ruhly Speaks on Rack Coatings

The Denver Branch met on Friday, October 13, at the Oxford Hotel, Denver, Colorado.

A total of 23 members and ten guests were present for dinner. Five members arrived later for the meeting, making a very good showing of 38 persons.

The meeting was called to order by President **Bob Whyman.** Minutes for September meeting were read by Secretary **Curt Johnson,** and a report of finances was given by Treasurer **Jim Lewis.**

Earl Goecker, educational chairman, introduced the speaker, **King Ruhly,** general sales manager, Chemical Division, Michigan Chrome and Chemical Company, Detroit. Mr. Ruhly spoke about rack coatings, stop-off materials, and the

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The November meeting is to be held at Aircraft Mechanics in Colorado Springs.

Curt R. Johnson
Secretary

DALLAS-FORT WORTH
Crain Talks on Filtration; Allie 1967 Convention Chairman

The Dallas-Fort Worth Branch held its regular October meeting in the banquet room at Amon Carter Field, Fort Worth International Airport. Some 40 members and guests were in attendance

Richard (Dick) Crain, sales engineer of Industrial Filter and Pump Mfg. Company of Cicero, Illinois, presented a well-illustrated talk on filtering industrial wastes and its relationship to land and stream pollution.

In the business portion of the meeting, delegates **Fred Howard, E. R. Rinehart** and **Don Allie,** and alternates **John Ladd, Gordon Brown** and **Jack Haler** were elected for the 1962 Milwaukee Convention.

Bill Aves, past president and board member, reported on AES Research Project 20, "Plating by Thermal Decomposition." An initial report is now in preparation.

Don Allie, general chairman for the 1967 AES Convention to be hosted by the Dallas-Fort Worth Branch, presented a list of Committee Chairmen recently selected by the Branch Executive Committee. A plan was outlined requiring currently limited participation, followed later with full participation, by chairmen and committee members.

A farewell gathering committee reported on **Myron E. Browning,** who departed from the Dallas-Fort Worth area to Alexandria, Virginia. Myron, AES workhorse the past eight years, past Branch president, Regional research chairman and member of the National Membership Committee, is now associated with American Machine & Foundry after some eight years at General Dynamics/Fort Worth. **E. R. Rinehart** will fulfill duties formerly carried by Mr. Browning.

Earl Turns
Recording Secretary

DETROIT
Barrett Discusses Sulfamate Solutions

The Detroit Branch held its monthly meeting Friday evening, October 6, at the Statler Hilton Hotel. The guest speaker, **Richard C. Barrett,** president and director of research of Barrett Chemical Products, Inc., of Shelton, Connecticut, addressed the Branch on "Electroforming and Electroplating from Sulfamate Solutions," giving the history of the development and application of sulfamate solutions.

I. M. Weiss, chairman of the AES Membership Committee also spoke to the Detroit Branch on the importance of maintaining an active and up-to-date membership roll.

The members were again reminded about making plans for the annual educational session and annual banquet held December 1 and 2.

William P. Devan
Public Relations Chairman

HARTFORD
Local Panel Covers Variety of Subjects

The Branch meeting was held at the Bond Hotel on Oct. 16; 46 members and guests were present. Preceding the meeting a movie in color entitled "For Immediate Action" was shown.

This meeting was termed "Local Talent Night" with several speakers on the panel covering a variety of subjects. First speaker, **Robert Tiers,** chose as his subject, "Plating of Aircraft Bearings and Experiences in Metal Cleaning." Mr. Tiers discussed the plating of aircraft steel bearing parts with silver, then lead, then indium and then oil baking for diffusion of the indium. After automation various problems arose due to poor connections with the plate skipping to the various parts resulting in non-uniform plate.

The next speaker was **Edward Crandall** whose subject was "Nickel-Chromium Plating of Percolaters." After automation of the plating line many blisters appeared on the lead spout after the nickel-chromium coating. The use of a warm fluoboric acid etch of the lead spout helped eliminate the blisters. Various kinds of nickel were tried such as a dull nickel followed by buffing and also various bright nickels. Problems arising from chromate contamination of the copper cyanide bath were discussed as also was the use of sodium hydrosulfite which in this case did not help eliminate blistering.

Arthur Lamson spoke on "Precious Metal Plating." Mr. Lamson mentioned the use of gold plating of electronic parts, parts used in the nuclear field and aircraft for corrosion protection. The cyanide bath was covered. The lack of meaningful specifications was mentioned.

Next speaker was **George Colombie** whose subject was "Unanswerable and Unusual Problems in the Life of a Plating Supply Salesman." Mr. Colombie covered some of the unusual problems that he has run up against in various plating plants while a salesman of plating supplies.

The last speaker was **Arthur Zavarella** who discussed "Gun Finishes and Gun Barrel Plating." Mr. Zavarella covered the black oxide and phosphate coatings of gun parts. Problems arising from automation were mentioned and Martin hard coating of aluminum was covered. Because of improper agitation, these parts were being corroded away in places while in the bath. Vapor plating of fiber glass parts, plating of springs by mechanical methods to avoid hydrogen embrittlement and phosphate coating of cadmium plate for longer corrosion resistance were briefly mentioned.

The technical chairman for the evening was **Arnold Johnson.**

Stanley Platoz
Secretary

LANCASTER
Carlson Presents Address on Fluoborate Baths

On Friday, October 13, the Lancaster Branch held their regular meeting at the Overlook Country Club, Lancaster, Pa. Following a buffet style dinner, the meeting was called to order by President **George Geesey.** Twenty-five members and guests were present. The business portion of the meeting was short as the only major item to act on was the voting of one applicant into membership.

The secretary introduced the speaker for the evening, **A. E. Carlson,** General Chemical Division, Allied Chemical and Dye Co., who gave an interesting talk on the various fluoborate plating baths, including copper, nickel, cadmium, tin, and various alloy baths. His address was supplemented by a set of slides of typical installations and applications.

Joe H. Shockcor
Secretary-Treasurer

LOS ANGELES
Stevens Talks and Shows Movie on Coated Abrasive Belts

The Los Angeles Branch of the American Electroplaters' Society held its regular monthly meeting, Wednesday evening, October 11 at the Rodger Young Auditorium. President **Emmett Babcock** called the meeting to order at 8:15.

Bob Jones, sergeant-at-arms, introduced one guest. Last month's minutes were read by **Harold Wanamaker. Norman McEwan** gave the treasurer's report in the absence of **Bob Poole.** Vice President **Harvey Hunt** gave a short report on membership and introduced the new applicants.

President Babcock appointed **Barry Blackburn,** general chairman of the annual technical session and dinner dance, to be held in March, 1962.

A short election was held for delegates to the National Convention for 1962. Emmett Babcock, **Frank Eddy** and **John Millhorn** were elected as delegates and **Tony Stabile, Gene Weiner** and **Gene Bosl** as alternates.

Gene Bosl, educational chairman, introduced the speaker for the evening, **Fred Stevens,** sales manager, Los Angeles industrial sales, Behr-Manning Co. He presented a very informative talk on "New Concepts in the Use of Coated Abrasive Belts," accompanied by a sound and color

LOUISVILLE BRANCH'S ANNUAL LADIES NIGHT AT THE RICHMOND BOAT CLUB

Thirty-six Louisville Branch members attended the annual Ladies Night dinner-dance on October 19. Branch President James Smith welcomed the group. Kenneth Reifsteck presented the door prizes and Frank Lamping was in charge of the arrangements. Standing, l to r, Librarian and Mrs. Reifsteck, Treasurer Gordon Blue with guest Miss Betty Tichenor, President and Mrs. Smith, First Vice President and Mrs. Harlan Bowsher. Far side of table, l to r, Stan Beyer, Mr. and Mrs. Charles Peters, Mrs. and Mr. Robert Mooser, Mr. and Mrs. Dave Buttorf, Secretary Charles Whitt, Ralph Chace, Herbert Kennedy, Fritz Anderson, Mrs. and Mr. Ed Breedlove. Near side of table, l to r, Mrs. Beyer, Mr. and Mrs. Frank Lamping, Mr. and Mrs. Harold Peters, Mrs. and Mr. Carl Smith, Mr. and Mrs. Bill Young, Mrs. and Mr. Art Oertel, Mr. and Mrs. Lyle Cates, Mrs. and Mr. Joe Turner.

motion picture entitled "Better Offhand Polishing with Coated Abrasive Belts." A question-and-answer period followed.

Harold P. Wanamaker
Secretary

LOUISVILLE

Vibratory Finishing Discussed by Brandt

The Louisville Branch held its first meeting of the year on September 21 at Hasenour's Restaurant, with approximately 30 people in attendance. After the dinner at 6:30 p.m. a brief business meeting was held. **Frank Lamping** gave a report on the readiness of the ladies' night meeting to be held October 19, at the Richmond Boat Club.

Delegates were selected for the 1962 National Convention to be held in Milwaukee. They are: **Gordon Blue, Lawrence Endicott** and **Stanley Beyer.** Alternates are **Kenneth Reifsteck, Harlan Bowsher** and **Arthur Oertel.**

Kenneth Reifsteck introduced the speaker, **William Brandt** and his guests **Orville Edwards, Carl Brandt, William Coleman** and **Freeman Mann,** all of the Pangborn Corporation. Mr. Brandt gave a very informative talk on vibratory finishing. With the use of samples, he pointed out the advantages of this process in comparison with the regular tumble finish process.

After the talk, refreshments were served by the suppliers, and Mr. Brandt and guests displayed their samples and answered questions for those who wished to remain.

Charles C. Whitt
Secretary

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MELBOURNE

Perkins Dies Suddenly; Bussell and Castell Present Papers

Branch organization has been somewhat disorganized by the sudden death of our secretary, **Gordon Perkins.** He was a very active worker in the Branch and our sympathies have been extended to his wife and three young children.

At the September meeting, **K. Bussell** of Defence Standards Laboratories delivered a lecture entitled, "What's New in Paints." In Australia, high-gloss, enamelized paints are used although the free-chalking white paints used in USA would probably be more suitable in a climate resembling that of Florida. Melbourne has a high sunshine level, high summer temperatures and also frequent rapid changes when the temperature falls as much as 40F in half an hour. This causes cracking of the gloss paints.

The speaker said that no really satisfactory clear finish had been developed for Australian conditions and external use. One well-advertised finish costing about $20 a gallon lasted three weeks on a Melbourne exposure rack and the best marine spars lasted only two years.

He also dealt with modern interior paints such as the PVA types and some of the problems of mould growth and sulfide staining. For automotive finishes, the acrylonitrile types were slowly replacing the cellulose lacquers.

He also dealt with the neoprene rubber and zinc-rich paints for industrial use, describing their properties and application.

A social event of note was the Golf Day at Sorrento on September 17. About 65 members and friends competed. The social committee had assured the green keeper that all were reasonably competent golfers but he must have had his doubts when one player took six strokes to clear the first tee.

H. Castell of International Nickel (Mond) Co., England visited Australia at our Branch invitation. He delivered a lecture on "The Status of Decorative Nickel/Chromium Plating" to the Branch on October 19.

The importance of his subject was reflected in the attendance of 85 members and visitors.

He reported the latest information on the accelerated tests and various aspects of the dual nickel and crack-free chromium systems with ample illustration by tables and micro-section photographs. Much of the data came from recent research at Birmingham not yet published.

In the discussion, he said that the labeling system was growing in England—some 200 signatories had already joined the scheme but the larger motor companies had not done so yet. This may be due to lack of confidence in the BS 1224 specification and the situation may be resolved only when the present intensive research gives guidance.

The recently published Australian specification, K97-1961, was discussed. The top-grade coating specifies a minimum local thickness of nickel of 0.0015 inch which meets the most rigid automotive requirements. The position in regard to the accelerated tests however, is not very satisfactory. Four tests have been included—the acetic acid salt spray, the sulfur-dioxide test, the CASS and the Corrodkote. In addition, two preliminary tests for the detection of gross porosity have been included—the ferroxyl test for steel basis metals and a similar test using potassium ferro-cyanide and ammonium chloride solution for zinc-base alloys.

Mr. Castell will also visit and lecture to the Adelaide and Sydney Branches.

L. Esmore
Assistant Secretary

MEMPHIS

Van Tilburg Talks On Copper Anodes

The regular meeting of the Memphis-Midsouth Branch held October 27, 1961 featured a talk on the OFHC Copper Anode. **Gerald C. Van Tilburg,** chief metallurgist of American Metal Climax, Inc., delivered an address on this subject for the first time to our Branch.

Emphasizing the anode side of copper plating Mr. Van Tilburg fearlessly discussed the somewhat controversial field of copper plating. Considerable interest in OFHC copper exists and Mr. Van Tilburg's informative talk is worth hearing.

Philip R. Dickinson
Secretary

MIAMI

Allen Accepts Honor; Wharton is Speaker

The October dinner meeting at the Pan Air Recreational Club was honored by the presence of the oldest living Past President of the Supreme Society, **Walter J. Allen,** and his son. He came to accept the Branch Honorary Membership to which he was elected in September.

Robert F. Wharton, Miami Branch member, of Grimes Research Center in Delray Beach, Florida, a division of Grimes Manufacturing Co., of Urbana, Ohio, who produce 80 per cent of aircraft lighting in the USA, was the speaker. He stated that all their designs are initiated in the pilot plant here, where practically every plating solution is in use, as well as heat treating, painting, plastic moulding, metal casting, sand blasting, polishing, buffing, and vacuum metalizing.

He had an elaborate display board illustrating the operation of many of their products in finished form and elaborated upon the processes employed in their manufacture, eliciting a lengthy question-and-answer period.

Mr. Wharton stated the cardinal re-

search principles as KNOWLEDGE, GOOD COMMUNICATIONS, EFFICIENCY, QUALITY and most important, PATIENCE.

Frederick Fulforth
Secretary

MILWAUKEE

Snyder on Quality Control, Walberg on Electrostatic Painting

Members and guests of the Milwaukee Branch met at 6:00 p.m. at the Maryland Hotel for dinner, after which Dimitri Kececiglu of the Milwaukee Technical Council spoke on the subject of the values of the Technical Council to the community, to individuals, and to the several scientific societies in the area.

President **Arthur Linn** presided at the regular business meeting during which **Henry Bornitzke** reported concerning progress made on the Branch directory and first Vice President **Clinton Host** described the activities of the membership committee. Two applications for membership were approved and the applicants were welcomed as new members.

After the business meeting, the members divided into two sections. **John Utech** introduced **Whitney Snyder** of American Motors Corp. to the Inorganic Section. Mr. Snyder spoke on the subject "Control of Quality of Plating on Rambler Cars." He described the procedures used in designing and engineering new models. According to Mr. Snyder, after designs are accepted by sales and development people, they are estimated by production engineering and the metallurgical laboratories which study the feasibility of manufacture and obtain needed changes before production is attempted. After production has begun, quality is carefully controlled within the specification requirements. Mr. Snyder attributed improved corrosion resistance of bumpers of recent manufacture to the increased use of duplex nickel plating and he predicted that service life would be further extended in the future.

Ted Sobczynski introduced **Arvid C. Walberg** of H. G. Fischer & Co. to the Organic Section. Mr. Walberg spoke on the subject of "Super-Charged Electrostatic Hand Guns." The speaker described and demonstrated the Fischer gun which atomizes paint with air and charges it to a negative potential of 100,000 volts. The guns are adjustable to compensate for changes in the dielectric qualities of the paints. The speaker stated that metallic paints can be used if the concentration of metallic pigments is low. In concentrations above 3 oz/gal the metal pigment particals tend to align themselves and short out the field. Mr. Walberg exhibited a short movie showing the gun in production use.

Leslie L. Diveley
Secretary

NEWARK

Old Timers Receive Plaques; Donroe Award Winner Announced

President **Al Korbelak** called the October 20 meeting to order at 8:45 p.m., with about 75 members and guests in attendance.

Ed Bertucio transferred into the Branch. Six applicants were elected to membership.

R. A. Ehrhardt was asked to present and install the Delegates and Alternate Delegates: Messrs. **Foulke, G. Wagner** and **Wesley,** Delegates; and Messrs. **Grigat,** Korbelak and **LaManna,** Alternate Delegates.

John Kosmos reported that the Christmas Party details were complete. Cy LaManna announced that the winner of the Lou Donroe Award for last year was **George R. Shaw.** Congratulations George, for a fine presentation on "Ultrasonics in Plating," which was given last February.

"Old Timers Night" was celebrated by inviting them to dinner. In addition, a plaque was presented to all Branch members with 25 years or more of service. President Korbelak presented plaques to the following old timers who were present: **D. Davies, W. F. Hodecker, P. Oldam, G. Reuter, P. Santella, S. Taylor, E. R. Van Der Hoef,** G. Wagner and Dr. W. A. Wesley.

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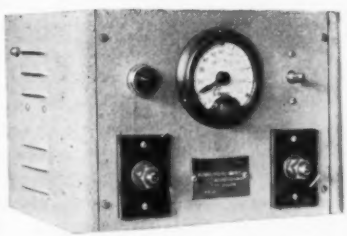

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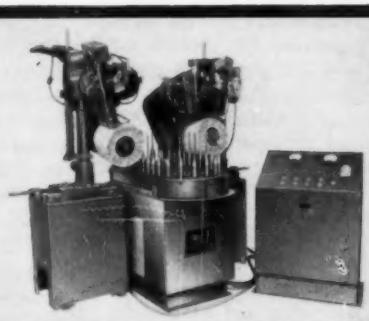

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Messrs. Reuter, Taylor and Dr. Wesley spoke briefly on the merits of being a Branch member.

An announcement of the sale of the "Introduction to Electroplating" booklet was made. The secretary would take orders if there was a sufficient demand.

Educational Chairman **Gene Wagner** introduced **G. Martusevich** whose timely topic was "Polarization and Passivity." Mr. Martusevich worked copper anodes as high as 1000 A/ft² in various types of plating baths in order to induce passivity of the anode. He used a novel means to hook up an oscilloscope to the anodes in order to record the results. He then showed curves illustrating the unusual passivity patterns of copper and phosphorized copper in various types of plating baths. Much work has yet to be done in order to more fully understand passivity.

Mr. Wagner next presented **Dr. Walter Meyer** who spoke on "Hazards in the Plating Room." Dr. Meyer felt that it is remarkable that there are not more accidents in the plating room, considering all the hazards. He first pointed out the very obvious hazards, such as hydrogen explosions, cyanide poisoning, solvent fires and discussed briefly how these accidents may occur. He then discussed the less obvious hazards—namely, dangerous mixtures such as cyanide and peroxide; cyanide and chlorite, which can be violently explosive; trichloroethylene and oxygen, which can react to form poisonous phosgene gas and many other hazards.

He also pointed out that the storage of chemicals can be hazardous, such as storing of flammable or volatile materials in the hot sun or shed; cyanides close to acids or chromic acid near organic materials. He then showed slides of fires or explosions which occurred in the plating room or storage areas.

Dr. Meyer then concluded his talk by demonstrating many hazards. He showed how ammonium dichromate, and sodium chlorite burned by supplying their own oxygen and fuel; the explosive reaction of chromic acid and alcohol bursting into flames. Finally, he ignited a mixture of ammonium nitrate and zinc by the addition of a small amount of water.

Dr. Meyer's lecture and demonstrations were very interesting and enlightening. He certainly kept us on the edge of our chairs.

Gustav Bittrich
Assistant Secretary

NEW YORK

New Branch Bylaws Adopted; Question/Answer Session Popular

President **Jack Weiner** called the Oct. 13 meeting at the Hotel Statler to order at 8:30 p.m.

President Weiner introduced **Dr. Hiroshi Asada** of the Aeronautical Research Institute of the University of Tokyo, here to attend the annual convention of The Magnesium Association.

Milton Nadel informed the members of the passing away of Messrs. **James Acierno, Sam Goldstein** and **Herbert Millwater.** A minute of silence was observed in memory of departed members.

Motion made and carried to accept one new member. The following were elected as delegates to the Convention to be held at Milwaukee. Delegates: Jack Weiner, Milton Nadel, **Isidore Friedman;** alternates: **Angelo Amatore, Joseph Rembecki, George Herrmann.**

The delegates to the Boston Convention received a rising vote of thanks for a job well done.

Chairman **Sol Adder** and members of Bylaws Committee received a rising vote of thanks for their labors on the new Branch Bylaws.

Librarian **Walter Schwartz** conducted a session on "Shop Problems and Answers to These Problems." All problems brought to the floor received answers from members who had similar experiences before. Walter promised to provide a large question box where members can put their large or small problems and the experts will give the answers.

Fred Saras
Recording Secretary

PHILADELPHIA

Thomas Discusses Plating Specifications and Tests

The regular Branch meeting was held at Beck's Restaurant October 23 with 38 at dinner and about 60 at the meeting. Guests were introduced, a new application was received and two applications were accepted. **Dr. Heiman** introduced members of his electroplating class, who gave their company, position and type plating done.

Following reading and answering of the questions from the Question Box, Educational Chairman **Marsh** presented **James D. Thomas,** General Motors Research Laboratories, who spoke on "Specifications and Tests for Automotive Plating." Mr. Thomas gave some of the historical background on the discovery, development and application of the salt spray test. He showed how this test changed with increased data obtained by outdoor performance checks. This resulted through AES research in the 1954 ASTM Committee B-8 report on the unreliability of the salt spray test results. Further AES research produced the CASS and Corrokote accelerated corrosion tests, which produced results readily correlated with actual service performance. Based on these tests, the current trend for plating specifications leans more toward performance and less on thickness.

Following Mr. Thomas, the secretary read minutes of the previous regular and Executive Group meetings; the treasurer made his report; the secretary gave a resume of receipts and expenditures since July 1, 1961. Branch President Hauseman announced the Annual Educational Session and Banquet committee chairman, the affair to be held March 2 and 3 at The Benjamin Franklin.

I. Wm. Marcovitch
Secretary

PITTSBURGH

Tank Linings Discussed by Kost

The Pittsburgh Branch opened its 1961–1962 season with a meeting at the Gateway Plaza on Wednesday, September 13. After dinner President **Chuck Forbes** opened the business meeting by having reports given by each Branch officer. Treasurer **Dick Cope** gave the financial report and also a report on 1961 ladies night. Educational Chairman **Walter Johnson** outlined the coming years' programs. Second Vice President **Ed Kost** reported on Sustaining Membership and First Vice President **Ed Keller** reported the activities of his membership committee.

Delegate **Myron Ceresa** reported on the Boston Convention and **Ed Smith** also made a few comments. **Dr. Leslie Lancy's** report was read by Secretary **Clyde Mungall** due to Dr. Lancy's absence. Three new members were elected.

Secretary Clyde Mungall also announced with regret the loss by death of **Orvil M. Null** on April 14. President Forbes turned the meeting over to Educational Chairman Johnson, who introduced the speaker for the evening. Little introduction was necessary since Edward L. Kost, the speaker, is our second vice president and has been active in the Branch for a number of years. Ed is general manager of the Industrial Lining Division of Chase Chemical Co. His subject was "Tank Linings and the Application Thereof." Ed explained some of the methods of application, testing methods, difficulties encountered, and causes for failure in tank linings. A question-and-answer period followed, then the meeting was adjourned by President Forbes.

Fred Stevens
Publicity Chairman

PITTSBURGH

Verlinich Speaks on Buffing and Grinding

The October meeting of the Branch was held at the Gateway Plaza on Wednesday, the 11th. Approximately 18 attended dinner to meet the speaker, **P. J. Verlinich** of Schaffner Manufacturing Co.

After dinner President **Chuck Forbes** asked for a roll call of Officers to open the

business meeting. Everyone was then asked to stand and state their name and company affiliation. One new member was welcomed into the group.

Before introducing the speaker, Educational Chairman **Walter Johnson,** announced that the Panel Discussion to be held at the November meeting was open to receive questions. The panel will consist of several "experts" of the Branch.

Educational Chairman Johnson introduced Mr. Verlinich whose subject was "Buffing and Grinding." After his talk Mr. Verlinich answered a number of questions from the floor and received a rising vote of thanks from the group.

Fred Stevens
Publicity Chairman

ST. LOUIS

McAleer Talks about Polishing and Buffing

The firs' fall meeting of the St. Louis Branch was held October 11 at the Elk's Club, 3617 Lindell Boulevard. There were 32 members and guests present for dinner. There were 37 present when President **Homer Thomen** called the business meeting to order. Four new members were accepted on a motion by **Andy Julius,** seconded by **William Piel,** that passed without opposition.

S. P. Gary, Liaison Officer for Midwest Regional Council has corresponded with our Educational Chairman, **Charles Hamm,** relative to members from our Branch that could speak at Midwest Branches, and by asking for reports from all Midwest Branches on the best speakers of the year better scheduling of programs could be the result.

The 25-year Certificate which is available was exhibited. A motion was made by **Walter Bogus,** seconded by **Lou Berra**, that the Branch buy the Certificates and have a presentation night and buy the dinner for the members receiving certificates.

St. Louis Branch has invited the next Midwest Regional Council Educational meeting to come to St. Louis. We could arrange to meet at Washington University or St. Louis University.

Craig McAlister mentioned we have some very intelligent people in the midwest and that the educational sessions are very enlightening and anyone who could, should attend.

Charles Hamm introduced **Howard J. McAleer,** president of Formax Mfg. Corp. Mr. McAleer is Chairman of the 1964 St. Louis Exposition. He talked on polishing and buffing. An interesting question and answer period followed his enlightening talk. Members gave Mr. McAleer a rising vote of thanks and meeting was adjourned 10:00 p.m.

Ward Kelly
Secretary

SANTA CLARA VALLEY

Duffek Presents Recent Electrodeposition Developments

The Santa Clara Valley Branch held its October meeting on Tuesday, the 10th, at the "Old Plantation Restaurant," Los Altos. President **Stanley Bammann** presided. Guests were introduced by the seargent-at-arms, **Tom Yagi.**

Charles Kuster, Educational Chairman, introduced the speaker, **Dr. Edward Duffek.** Dr. Duffek, Research Electrochemist, Stanford Research Institute, Menlo Park, California, presented a very educational talk on "Recent Developments in Electrodeposition of Metals.

Harold Smallman of the San Francisco Branch, outlined plans for a technical session to be held jointly by the Santa Clara Valley and the San Francisco Branches on March 3, 1962. Charles Kuster was appointed by President Bammann to work with **Cal Snelgrove** of the San Francisco Branch to finalize the details.

John E. Tracy
Secretary

SOUTHERN TIER

Millman on Nickel; Bates Honored

The regular Branch meeting was held on Oct. 17 at the Deep Well Restaurant, Owego, N. Y. After a fine dinner, President **Potter,** greeted the speaker, members and guests.

Jacques Linder, sitting in for the educational chairman, introduced the speaker, **William Millman,** of Lea-Ronal Inc. The topic of the evening was, "Bright and Duplex Nickel." Bill gave some interesting history on nickel plating dating back to 1860, and from the time that Adams discovered the nickel iron anode. He also explained the advantages of agitation in the bath for removal of the ion bubbles from the cathode to greatly reduce pitting. In the automotive industry, he said, there is a strict rule that the semi-brite nickel be sulfur free. The plating on bumpers is usually 75 per cent semi-brite and 25 per cent full-brite nickel, of the total thickness. The enlightening informative session was very much appreciated as judged by the applause.

President Potter, announced the reinstatement of one member and the election of a new member of the Society. A report of the summer outing was given by Chairman **Don Rake.** The annual Christmas Banquet plans were announced by Chairman **Charles Bound**—the date, Friday, Dec. 8. A country style dinner will be served; dancing will be from 9:00 p.m. to 1:00 a.m., at the American Legion Clubhouse on Clinton St., Binghamton, N. Y.

Member **Dewey Bates** who is retiring from IBM, was honored for his active years in the Branch and the helping hand he has given to many a plater. Dewey will reside in Florida, do a lot of fishing, and enjoy one of his favorite sports, auto racing. A great guy, he has promised to visit us in the spring.

John J. Bunsic
Secretary

SPRINGFIELD

Meyer Demonstrates Plating Room Hazards

The Springfield Branch met at the Wayside Restaurant on Tuesday, October 24 for the regular monthly meeting. The Branch will meet on Tuesdays for the balance of the 1961-1962 season. A suspension of rules was voted at the September meeting.

President **Louis E. Dupuis** appointed **Robert J. Girard** to the post of Research Fund Chairman.

In the absence of **Paul R. Lane,** who was drafted into the Air Corps, President Dupuis appointed **Donald W. Gemme** to fill out the term as Branch technical and educational chairman.

The activities committee requested more help for its group. President Dupuis appointed **Harry H. Johnson** and **William J. Giblo** to serve on this committee. A new member was voted into the Branch.

President Dupuis spoke on the Branch's part in the activities of the Valley Council of Technical Societies, and then introduced a guest of the Branch for the evening, **H. S. Busby,** one of the original organizers of the Council. Mr. Busby explained the value of membership in the Council of 16 Technical Societies. He stressed the need of a common pool of knowledge for the dissemination of technical information. He explained the need of a central headquarters for prompt and accurate circulation of information, a sounding board for the discussion of advancements of techniques in the common good, and correlation of findings and viewpoints for meetings, publications and libraries of interest to the 200 odd groups in the area served by the Council. Mr. Busby answered a number of questions, and then received a round of applause and a vote of thanks from those present.

Robert J. Girard, acting as technical chairman, introduced **Dr. Walter R. Meyer,** president of Enthone, Inc. The subject for discussion was "Safety Hazards in the Plating Room." Along with the talk, Dr. Meyer gave a number of actual demonstrations of the results of the careless handling of chemicals. There was smoke, fire and noise, and it sure gave realism to the talk. Bob Girard was ready with a fire extinguisher, just in case. I am sure the entire group will wholeheartedly agree that the talk and the demonstrations were a real eye opener, and of great interest, and very necessary. Thank you, Dr. Meyer.

Henry L. Heissfeld
Secretary

AES MEMBERSHIP REPORT

ELECTIONS

Allentown-Reading: H. R. Maack
Baltimore-Washington: H. A. Pierdon
Blue Ridge: G. D. Brooks, T. J. Morgan Jr., R. W. Phillips Jr., G. R. Watts Jr., C. S. Homola Jr.
Boston: D. E. Hewitt, J. H. Roche Jr.
Bridgeport: R. A. Sherwood, J. P. Raleigh, A. C. Hansen
Buffalo: M. F. Guercio, J. F. Dickens
Capitol District: H. F. Murano
Chicago: R. S. Thomson
Cincinnati: W. A. Hargan, J. W. Smith
Cleveland: D. V. Louzos, D. E. Swickard, J. M. Robertson, D. A. Richard
Dallas-Ft. Worth: M. J. Puma
Dayton: M. J. Powers, J. H. Zugelder
Detroit: E. T. Bartley Jr., R. F. Boneham, F. J. Curtis, M. W. Lovett, J. P. Lutfy, D. M. MacKay, D. P. Murphy, G. Rindt, L. Schlossberg, D. J. V. Snyder Jr., F. W. Zach
Indianapolis: B. C. Smith, R. A. Whitley
Kansas City: R. W. Weeks Jr.
Lancaster: R. M. Bragg
Melbourne: A. T. Corcoran, R. Douglas, J. M. Huggard, S. Kalbitzer, D. E. McKell, R. Paterson, F. M. Reeves, L. S. Royals, R. A. Raward
Miami: J. V. Demarest, W. W. Smith, L. Phillips, J. A. Barile, E. A. Hambacher, A. Clarke, D. E. Houston
Milwaukee: M. Figueroa, T. J. Banski
Mohawk Valley: J. J. Nivaggi, C. VanHorn
Newark: N. A. Ciccone, F. J. Frey, F. T. Gallico, J. C. Johnson, F. P. Travisano, R. Weil
New Haven: R. F. Smith, E. P. O'Connell
New York: L. Eccles
Philadelphia: J. F. Daley, C. R. Green
Pittsburgh: G. E. Sleigh, D. P. Cunningham, F. Mance, O. M. Wilt
Providence-Attleboro: G. H. Roitman
St. Louis: B. Hastey, J. G. Hicker Jr., O. F. Pearce, M. R. Crowell, N. W. Harris, L. Long
San Francisco: J. E. Anderson, E. L. Donovan, A. T. Nathan, R. M. Oliver, A. B. Powell, A. W. Simpson, H. Wong
Santa Clara Valley: M. E. Shaheen, M. D. Rosenthal
Southern Tier: J. Kostyun, N. Butenko, J. E. Linder, K. R. Furman
Springfield: M. F. Cardos
Syracuse: C. L. Alderuccio, J. D. Watson, J. F. Welch, W. DePan, R. L. Lee, A. Christopher
Waterbury: L. J. Hirbour
Member-at-Large: S. Simkins, B. Ro, J. Pigott, A. G. Hirsch, B. Tromans

REINSTATEMENTS

Boston: S. Aversa, A. B. Brunell, R. J. Cadiero, J. R. Chisholm, R. F. Gladu, H. A. Matheson, P. Woodberry, T. F. Perkins Jr., M. Levy
Columbus: John W. Dini
Milwaukee: T. Williams
Newark: S. D. Swann
New York: S. Ferenz, W. Friede
Philadelphia: G. C. Rossberg, L. Cetroni Jr., C. J. Davoli, M. J. Drozd, F. Harper, N. R. Coia, L. B. Doll, E. A. Erickson, K. Ermisch, M. Horoff
Pittsburgh: G. A. DeCario
St. Louis: H. Cissell
Syracuse: R. E. David
Toledo: G. Karmel, J. Lee, T. J. Limmex
Wichita: H. E. Gilmer
Member-at-Large: R. Fyfe

TRANSFERS

Baltimore-Washington: J. A. Henricks to Chicago
Bridgeport: R. T. Richards from Philadelphia
Chicago: G. Lyons from Newark
Cincinnati: L. A. Helmich to Kansas City
Columbus: G. Osterfeld to Dayton
Dayton: G. J. Osterfeld from Columbus
Denver: D. P. Ignacz
Newark: R. Rochat from Member-at-Large, W. Fluehmann from Member-at-Large, E. C. Bertuccio from Baltimore-Washington, G. Lyons to Chicago
New York: J. Russo to Los Angeles
Toronto: R. Chalut

RESIGNATIONS

Buffalo: W. H. Hesch, R. N. Spencer, T. A. Todaro
Capitol District: G. Miller, C. Stella, F. Leone
Central Michigan: L. Reiman, C. L. Welch
Cincinnati: W. Halker
Cleveland: W. Henry, R. Hess, J. Palik Jr., S. P. Pozone, J. H. Richards, H. M. Zimmerman
Columbus: M. Farr, W. Schickner
Detroit: H. G. Wissman, R. J. Amis, D. R. Ford, A. F. Krivacs
Grand Rapids: H. Bussing
Melbourne: F. J. Boatwood, D. W. Donaldson, D. W. Trimble
Mohawk Valley: T. Patrick
Newark: K. Compton, W. Treadwell
New Haven: H. B. Smith
Pittsburgh: L. R. Hoak, E. Johnson, F. Keller, J. L. Kelly
Providence-Attleboro: J. Hafner, F. Horlbeck
St. Joseph Valley: V. Peterson, E. Roth, A. Wiegand, J. V. Lawton
St. Louis: J. R. Cassani, J. L. Rice, L. Smith, R. T. Ganley
San Francisco: D. A. Huff, R. M. Porter, F. Wade
Southern Tier: J. P. Landre, R. B. Wells
Springfield: E. Finnie, J. F. Horrigan, E. F. Koetsch Jr., F. E. Chagnon
Sydney: K. Deutch
Syracuse: J. H. Corbett
Toronto: H. Bird, J. H. Cresswell, H. Reece, J. A. Takanashi

SUSPENSIONS

(Mainly Annual Per Capita Tax Streamlining)

Allentown-Reading: R. H. Troxell
Boston: S. Aversa, A. B. Brunell, J. W. Bellman, R. J. Cadiero, R. A. Carbone, J. R. Chisholm, A. Corrado, S. Dakesian, C. DeBenedict, R. J. Gagne, R. F. Gladu, W. Henry, W. V. Jennings, A. Jorjorian, M. Levy, H. A. Matheson, K. I. Tornroos, D. L. White, A. F. Wilde, P. Woodberry, J. H. Anthony Jr., D. G. Earnshaw, L. Epstein, R. Fluke, W. L. Larsson, J. E. McGowan, F. W. Martin, E. N. Mills, P. S. Morin, H. W. Symonds, D. A. Teoli, M. J. Zopotti
Cincinnati: K. Edstrom, H. Follmer, H. Kemp, J. Ludmann, R. L. Miller, C. Wallace
Cleveland: I. Bartrug, C. Borowski, R. Botosan, W. E. Carpenter, G. Chimples, L. Fuelling, R. J. Grayson, T. W. Gulley Jr., C. E. Hayes, S. J. Henry, E. G. Huth, W. P. Karash, J. N. Land, T. F. Lamp, J. K. Lilly, N. Marsico, J. F. Revilock, G. R. Shope, D. H. Snelgrove, L. C. Sobey, A. F. Spencer, F. Sztul, J. J. Vanas, J. W. Weaver, M. Yuhas
Dayton: J. G. Schirtzinger
Detroit: V. P. Aluzzo, L. E. Anger, L. G. Belanger, S. T. Bilger, J. W. Bonk, H. Bradley, E. M. Bunjac, C. E. Campbell, W. D. Carnegie, S. J. Cascio, F. J. Connor, F. Cook, D. Denton, R. E. Dorsch, J. T. Ellis, A. D. Estrada, B. P. Freedland, R. F. Gach, J. Gassel, G. L. Hager, W. R. Hautamaki, L. J. Hawk, J. A. Herrmann, W. L. Herrmann, T. Hunzicker, P. Jaruckna, A. F. Joseph, A. Klimecki, R. O. Kline, G. H. Knipple, H. R. Kosloski, A. Kujawski, A. W. Kurz Jr., P. Leenders, V. J. Lindsdeau, L. J. Mahoney Jr., Z. Majzoub, S. Markiw, A. R. Marshall, D. C. Martyn, L. A. Mead, N. J. Merkin, J. Miller, J. L. Mitchell, J. Mulvihill, J. M. Northrup, S. H. Obey, S. Pawlak, F. G. Polard, Wm. H. Ross, D. J. Schindebette, C. T. Schmoke, E. J. Schultz, M. Schuster, L. F. Senick Jr., P. W. Sheppard, J. W. Smith, J. W. Taylor, H. S. Trembath, P. F. Tresnan, B. A. Tye, E. A. Ulbrich, R. E. Verbick, R. Woltmann, C. V. Wilkie, N. G. Wirick, S. L. Withrow, L. P. Wroblewski, M. E. Young, H. Zielinski
Grand Rapids: F. J. Darling, R. G. Martin, T. O'Callaghan
Hamilton: T. L. Armitage, B. Irwin, W. D. Christianson, C. York, R. J. Harrison, A. G. Andrews, R. A. Hevitt
Kansas City: H. D. Burgess, J. B. Carduff Jr., F. M. Gilbert, E. L. Lackland, R. E. Lee, M. L. Marcum, J. L. Marti, W. H. Mumma, D. L. Onwiler, W. C. West
Los Angeles: A. G. Cafferty, W. M. Cambridge, M. Carraro, A. Clauss, A. J. Cram, D. Davis, W. Davis, E. George, N. W. Green, E. E. Hamor, J. B. Hamor, C. Humbert, J. W. Hunker, J. Kempker, V. Herbert, F. Kilmer, R. B. Lastutter Jr., K. D. Mays, J. Molina, V. M. Padilla, A. Perkins, G. A. Peterson, J. L. Pifer, R. C. Platt, E. W. Rynkofs, M. D. Rynkofs, S. M. Rynkofs, D. Schein, J. H. Schneider, F. Serot, L. Sherman, C. B. Simon, F. Stabile, F. H. Thurber, C. Troncale, J. A. Weaver, H. Woodward, H. C. Steinke
Louisville: N. M. Follett, L. D. Mattei, R. D. Wallin
Melbourne: A. P. Howell, G. Partell, M. S. Pennisi, R. J. Smith
Miami: A. A. Tetrault, E. Owens, L. T. Berry, H. H. Oakley, C. W. Flanigan, W. W. Hopkins, J. V. Liles, J. Vairetta
Mohawk Valley: J. Bension, K. Duck, J. Geer, R. Howard, E. Stys
Phoenix: T. J. Geare, J. R. Maggard, L. T. Medkiff
Pittsburgh: G. A. DeCario, R. Diaz, K. F. Hittle, D. F. Porter, W. H. Ralshouse
Rockford: R. W. Chapdelaine, C. Jensen, R. W. Johnson, T. N. Kiefer, J. D. Mead, D. Meads, J. O'Neil, R. Twyning, L. A. Weber
St. Joseph Valley: M. Anderson, N. Boomershine, D. R. Culp, R. Sprague Jr., M. Van Dierendonk
St. Louis: F. J. Dandridge, R. Goodman, W. Ripplemeier
San Diego: J. W. Peyton
San Francisco: M. Hart Jr., H. McQuain, M. Meade, W. R. Perry, F. R. Pierson, P. H. Rollason, S. Schroder, J. Battaion, J. L. Beals, E. C. Call, J. Call, P. Carter, P. Ignacz, A. A. Kahn, L. Janover Jr., R. Lathrop
Seattle Puget Sound: P. H. Grimm
Sydney: R. M. Brown, A. Cornell, A. H. Coyle, F. James, J. Lean, E. Merriman, M. F. Page, N. Paltos, M. E. Phelan, G. R. Richardson, T. E. Wilson
Syracuse: R. Byers, E. Campany, D. J. Costello, W. Langmayer
Toronto: G. E. Chapman, D. B. Johnston, W. E. Mark, W. W. Smallman, W. H. Thomas, R. R. Warner
Member-at-Large: L. Ades, B. B. Bansal, E. F. Ben-Menachem, J. W. Carr, P. DePietro, T. E. Dickinson, W. W. Diekmann, F. E. Firth, E. A. Fonseca, M. Fraze, W. Gardner, L. A. G. Herrera, L. C. Harvey, P. P. Jorda, E. W. Journey, P. R. Kirwood, F. Lank, G. Netto, G. M. Page, R. Reitsema, P. Ritt, W. G. Strickler, L. C. Suhostavsky, C. Wharrad

DEATHS

Chicago: L. M. Glassner
Cleveland: L. G. Nicoulin
Grand Rapids: J. H. Rohdy
Melbourne: G. J. Perkins
New Haven: J. M. Cooke
New York: J. Lustgarten
Springfield: F. J. Crowley

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BRANCH EDUCATION

ROCHESTER ELECTROPLATING COURSE OPEN FOR ENROLLMENT

A 15-week course in electroplating and metal finishing will be held at the University of Rochester, Rochester, N. Y., starting in February 1962. Frank O. Beuckman of Eastman Kodak Company, AES National Second Vice President, will again be the instructor. Enrollment is already open.

The correspondence course prepared for the American Society for Metals by Dr. William Blum is used in this course, which is conducted in conjunction with the ASM. It comprises the basics of electroplating and metal finishing. No specific prerequisites are necessary other than a desire to learn. Classes are of two-hour duration. Lectures based on Dr. Blum's text are supplemented by the instructor with demonstrations, exhibits and other instructive material.

The fee for the course is $75.00. Although the course is conducted at the University, no college credits are given.

PLATING MAGAZINE invites AES Branches to furnish news for publication in PLATING concerning electroplating courses sponsored.

ELECTROPLATING COURSES

BROOKLYN, N. Y.—Ft. Greene Evening High School
Louis Serota, Instructor
18-wk. course—Fee: None

CHICAGO, ILL.—Illinois Institute of Technology
J. M. Andrus, Instructor
18-wk. course—Fee: $80

CLEVELAND, OHIO—Max S. Hayes Trade School
H. Pochapsky Instructor
15-wk. course—Fee: $11

INDIANAPOLIS, IND.—Purdue University Extension
Dr. A. M. Max, Instructor
16-wk. course—Fee: $45

MONTREAL, QUE.—Polytechnique Institute
Dr. Andre Hone, Instructor
3-year course—Fee: $50

NEWARK, N. J.—Plants and Laboratories in Area
F. J. LaManna, Instructor
Climax-Grayway Co., 560 Winters Ave., Paramus, N. J.
14-wk. course—Fee: $25

NEW HAVEN, CONN.—New Haven College
L. J. Durney, Instructor
4-15 wk. Semesters—Fee: $50 per semester
Sept. 1961–Jan. 1962—Electroplating Practice
Feb.–June 1962—Electroplating Fundamentals
Students may enter at any point.

PHILADELPHIA, PA.—Temple University Technical Institute
Dr. S. Heiman, Instructor
4 Semesters, each 16 wks.—Fee: $37 per Semester

PORTLAND, OREGON—Portland State College
Dr. J. R. Mickelsen, Instructor
10-wk. course —Fee: $10

PROVIDENCE, R. I.—Central Senior High School
Omer Jette, J. Fogarty, J. Castriotta Instructors
2-year course—Fee: None

ROCHESTER, N. Y.—University of Rochester
Frank O. Beuckman
15-wk. course—Fee: $75
Starts February 1962

ST. LOUIS, MO.—Hadley Technical H. S.
Dr. Otto C. Klein, Instructor
16-wk. course—Fee: $10

SAN ANTONIO, TEX.—Trinity University
W. P. Wisdom, Instructor
18-wk. course—Fee: $10

SAN FRANCISCO, CAL.—Cubberly H. S., Palo Alto
William Ferry, Instructor
24-wk. course—Fee: $3 per 12-wk semester

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R. H. Clark, Instructor
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$ 5—city res.

VANCOUVER, B. C.—Vancouver Technical School
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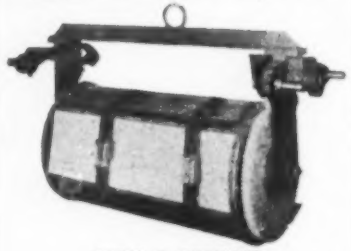

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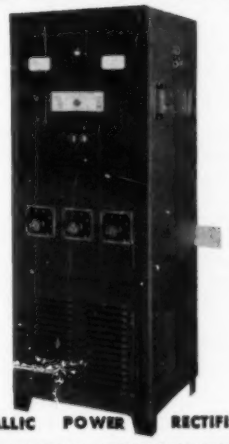

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FUTURE MEETINGS

AMERICAN ELECTROPLATERS' SOCIETY

December 9, 1961—**Buffalo Branch, Annual Christmas Party,** Red Lobster, Buffalo, N. Y.

Dec. 15-16, 1961—**Newark Branch Annual Educational Session and Banquet,** Robert Treat Hotel, Newark, N. J.

December 16, 1961—**Bridgeport Branch Dinner-Dance,** Stratfield Hotel, Bridgeport, Conn.

January 11, 1962—**Editorial Board Meeting,** Hotel Marott, Indianapolis, Indiana.

January 11-14, 1962—**Executive Board Meeting,** Hotel Marott, Indianapolis, Indiana.

January 13, 1962—**Ninth Interim Meeting, Supreme Society,** Hotel Marott, Indianapolis, Ind.

January 20, 1962—**Grand Rapids Branch Annual Meeting,** Pantlind Hotel, Grand Rapids, Mich.

January 26, 1962—**Research Committee Meeting,** Conrad Hilton Hotel, Chicago, Ill.

January 27, 1962—**Chicago Branch Annual Educational Meeting and Banquet,** Conrad Hilton Hotel, Chicago, Ill.

February 9-10, 1962—**Fourth Annual Dixie Regional Educational Meeting,** Dinkler-Plaza Hotel, Atlanta, Georgia

February 17, 1962—**New York Branch Annual Technical Session and Banquet,** Hotel Statler-Hilton, New York, N. Y.

March 2-3, 1962—**Philadelphia Branch Annual Educational Session and Banquet,** Benjamin Franklin Hotel, Philadelphia, Pa.

March 3, 1962—**Eighth Annual Tri-State AES Regional Educational Session and Banquet,** Biltmore Hotel, Dayton, Ohio.

March 3, 1962—**Far Western Regional Technical Session,** San Francisco, Calif.

March 27, 1962—**Toronto Branch 2nd Annual Metal Finishing Technical Symposium,** Seaway Hotel, Toronto, Ontario, Canada.

April 13-14, 1962—**Executive Board Meeting,** National Headquarters, Newark, N. J.

April 14, 1962—**Baltimore-Washington Branch,** Order of Past Presidents' "Pot" Presentation and Banquet, Bonnie View Country Club, Baltimore, Md.

April 21, 1962—**23rd Annual New England Regional Meeting,** Hotel Statler, Hartford, Conn., Springfield Branch, Host.

FUTURE MEETINGS

May 1, 1962—**Central Michigan Branch,** Annual Educational Session and Banquet, Hotel Hayes, Jackson, Mich.

May 25-26, 1962—**Far Western Regional Educational Session & Banquet** Northern Section: Portland, Seattle-Puget Sound and British Columbia Branches), Olympic Western Hotel, Seattle, Washington.

June 24-28, 1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

January 19, 1963—**Tenth Interim Meeting, Supreme Society,** Kansas City, Missouri.

June 24-27, 1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City. N. J. Sponsorship Newark Branch.

June 15-18, 1964—**51st AES Annual Convention,** Sheraton-Jefferson Hotel, St. Louis, Missouri.

June 16-18, 1964—**Sixth Industrial Finishing Exposition,** St. Louis, Missouri.

June 28-July 1, 1965—**52nd AES Annual Convention,** Statler Hotel, New York, N. Y.

June 26-30, 1966—**53rd AES Annual Convention,** Hotel Fontainebleau, Miami, Florida. Dixie Regional Council, Sponsor. Southeastern Branch, Host.

June 1967—**54th AES Annual Convention,** Dallas, Texas

INTERSOCIETY

Jan. 30-Feb. 2, 1962—**Society of Plastics Engineers,** 18th Annual Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

February 5-9, 1962—**American Society for Testing Materials,** Committee Week, Statler-Hilton Hotel, Dallas, Texas

March 6-7, 1962—**Society of Vacuum Coaters.** 5th Annual Technical Conference, Sheraton-Cleveland Hotel, Cleveland, Ohio

March 19-23, 1962—**National Association of Corrosion Engineers, 18th Annual Conference, and Corrosion Show,** Kansas City Auditorium, Kansas City, Mo.

May 6-10, 1962—**The Electrochemical Society,** Spring Meeting, Statler-Hilton Hotel, Los Angeles, Calif.

June 24-29, 1962—**American Society for Testing Materials,** Annual Meeting and Apparatus Exhibit, Statler-Hilton Hotel, New York, N. Y.

Sept. 16-20, 1962—**The Electrochemical Society,** Fall Meeting, Hotel Statler-Hilton, Boston, Mass.

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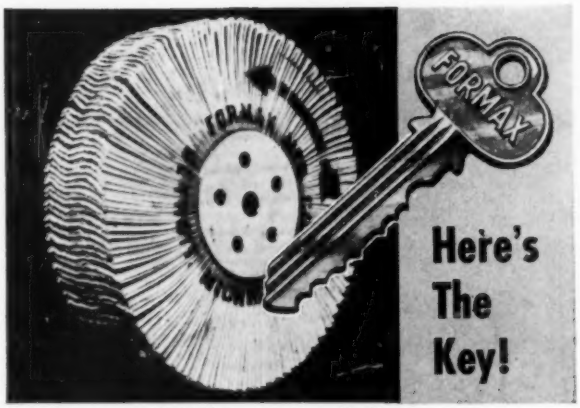

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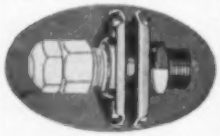

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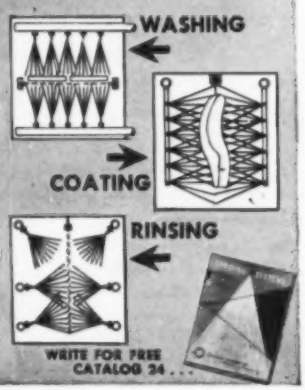

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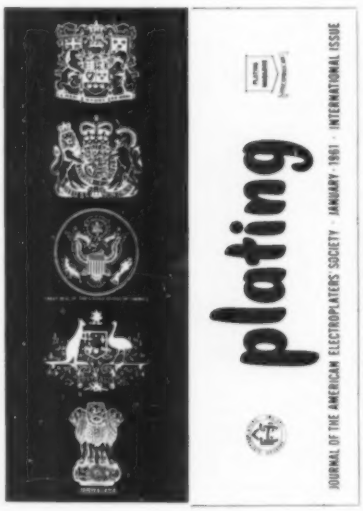

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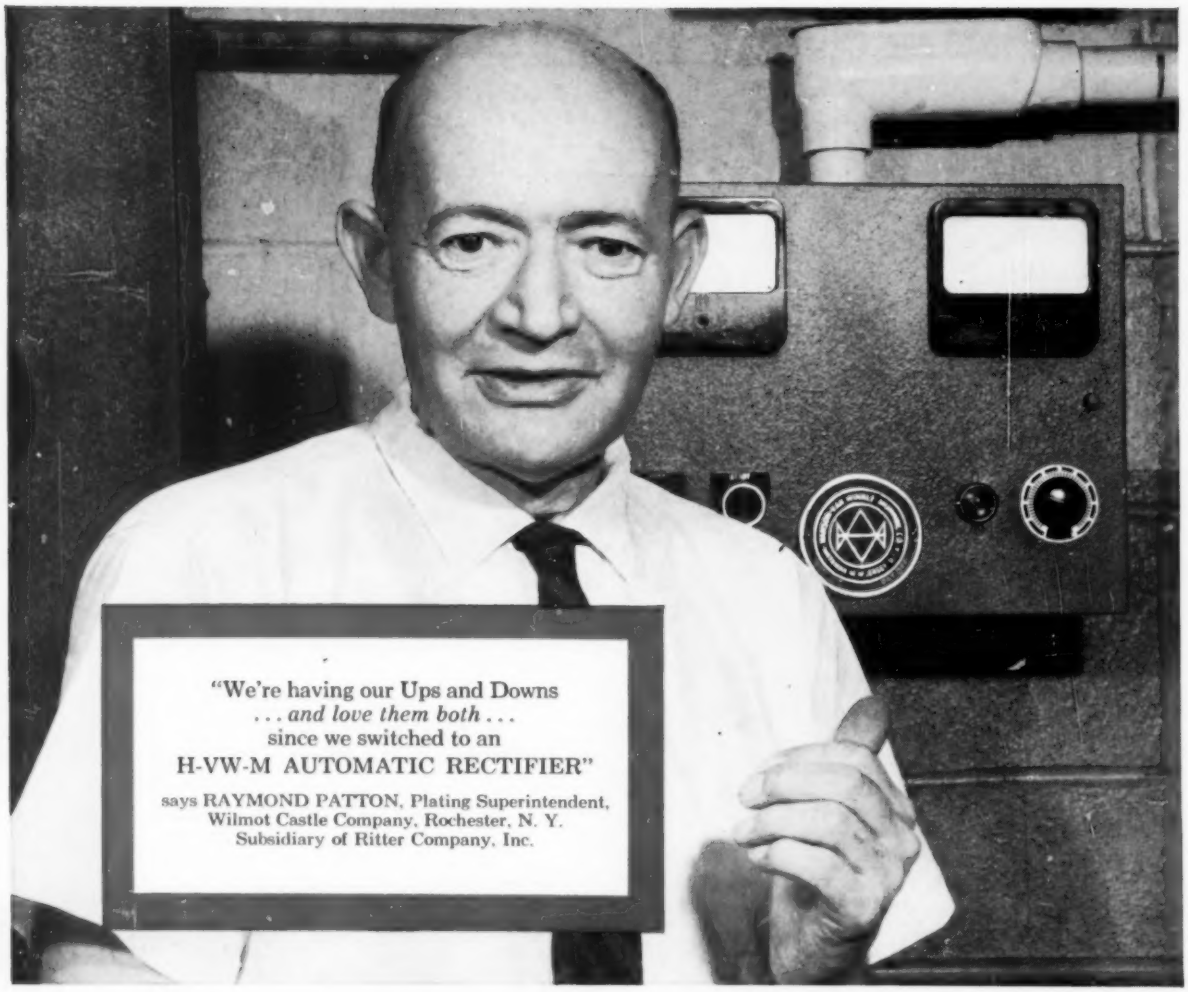
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